Qteq

Wireline services catalogue

Qteq Measurement Systems





Solution Mining











Coal Mining

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Brochure Rev. Aug-2019 (A)

INDEX MEASUREMENT CAPABILITIES

Qteq

1. Logging Units

- 1. <u>CGS</u>
- 2. Zero Force Logging Unit
- 3. <u>Landcruiser</u>
- 4. <u>Demountable Skid Unit</u>
- 5. <u>Mobile Logging Platform</u>

2. Open Hole services

- 1. Dual Density Combination Sonde (DDCS)
- 2. Lithology Density Tool (LDP)
- 3. Dual Laterolog Tool (DLT)
- 4. Micro Spherical Focused Tool (MST)
- 5. <u>Phased Induction / SFL Tool (PIT)</u>
- 6. <u>Neutron Deviation Resistivity Sonde (NDRS)</u>
- 7. <u>Compensated Neutron Tool (CNP)</u>
- 8. Formation Sonic Sonde (FSS)
- 9. Compensated Sonic Tool (CST)
- 10. Spectral Gamma Ray (SGR)
- 11. Spectral Gamma Ray Telemetry Rm Tool (SGRT)
- 12. Borehole Magnetic Resonance (BMR)
- 13. Magnetic Susceptibility Sonde
- 14. Acoustic Formation Imager (AFI)
- 15. Optical Formation Imager (OFI)
- 16. Four Arm Dipmeter Sonde (DMS)
- 17. Wellbore Orientation Tool (WOT)
- 18. <u>Formation Evaluation Tool (FET)</u>
- 19. Borehole Geometry Sonde (BGS)

3. Cased Hole services

- 1. <u>Ultrasonic Casing Imager (UCI)</u>
- 2. Optical Casing Imager (OCI)
- 3. Downhole Camera (CAM)
- 4. <u>Cement Bond Log (CBL)</u>
- 5. Radial Bond Log (RBL)
- 6. <u>2³/₄" Radial Bond Log Tool (RBL)</u>
- 7. Impeller Flowmeter Sonde (IFS)
- 8. <u>Plug/Packer Setting Tool (BST)</u>
- 9. <u>Perforating Systems</u>
- 10. Pressure Activate Firing Head (LP) (PAFH)
- 11. Radial Cutting Torch (RCT)
- 12. Perforating Torch Cutter (PTC)

INDEX MEASUREMENT CAPABILITIES



4. Ancillary services

- 1. <u>Downhole Fluid Sampling Tool (DFST)</u>
- 2. Motorised Free Point Tool (FPT)
- 3. Back Off Service (BO)
- 4. Three Arm Caliper (3CAL)

5. **Gyroscopic deviation**

1. <u>Gyroscopes</u>

6. Data services

1. Data services



COMPANY PLEDGE

0129

Qteq

Following its incorporation in June 2017 and the acquisitions of WellDog (Aug-2017), NMR Services Australia (Oct-2017), Surtech Systems and WellServ (Jul-2018), Qteq has become a leading service provider to the georesources industry in Australia and across the world.

As a technology focused service company, we **deliver real-time, actionable subsurface data** to the mining, groundwater, oil & gas and alternative energy sectors.

Our large selection of logging services, used to characterise mineral resources, are deployed using a variety of **purpose-built**, **highly efficient wireline units** that are custom designed and fabricated in-house to meet client and regulatory requirements. Our excellent quality, health, safety and environmental systems allow us to work in remote locations, environmentally sensitive areas and wherever expert well site, exploration and mine site services are required.

With safety as our top priority, we take our obligation to ensure the health and safety of our employees, subcontractors, clients and the environment very serious.

We are relentless in our pursuit to **achieving** "Goal Zero" and subscribe to and are active members of industry initiatives to ensure and improve the safety of all those affected by, and involved with our industry.

Our mission

We improve the sustainability and productivity of the world's georesources industries by strengthening our clients' commercial and environmental operations. We do so by transforming the relationship between technological excellence and cost performance, while maintaining a relentless focus on safety and service quality.

Our vision

To lead change in georesources industries through technical and commercial innovations that protect the environment and enhance our clients' social license to operate.

Our values

Qteq identifies with guiding principles that define the behaviour of our company and our people. Our employees are assessed in part on their commitment to these values in their daily work.

"Our success is based on building strong and long term customer relationships and producing outstanding client results."

ABOUT QTEQ & MEASUREMENTS

We are renowned for our advanced technologies that **measure** and **monitor** the subsurface, enabling our clients to **manage** and **mitigate** their technical, commercial and environmental risks. Our wireline services include:

- Gyro Survey and Borehole Trajectory measurements
- Total and Spectral GR measurements
- Neutron and Density measurements
- Resistivity measurements (Laterolog and Induction)
- Cased hole evaluation services
- Borehole Magnetic Resonance services
- Acoustic and Optical Imaging Logs
- Magnetic susceptibility
- Perforations, plugs and packers
- Wellbore integrity
- Well decommissioning services
- Spectroscopy measurements
- Downhole cameras

Quality Systems Certification

Dteq

- ISO 9001:2015
- ISO 14001: 2015
- ISO 55001:2014
- AS/NZ 4801:2001
- OHSAS 18001:2007

TO SHINE A LIGHT ON YOUR SUBSURFACE GEORESOURCES, WE **MEASURE** AND **MONITOR**, SO YOU CAN **MANAGE** AND **MITIGATE**.

QTEQ MEASUREMENTS SYSTEMS, YOUR PARTNER FOR:

- Geotechnical and Geomechanical logging
- Geophysical and Petrophyscial logging
- Borehole imaging and Downhole cameras
- Cased hole services
- Log interpretation and Data services

WIRELINE SERVICES

TECHNICAL SPECIFICATION SHEETS

LOGGING UNITS

(CSG)



Coal Seam Gas | Oil and Gas | Hydro | Unconventional

The Qteq wireline logging unit combines a dedicated and purpose built logging van mounted on a 4WD rigid truck chassis, coupled to a slew crane. This integrated unit has been designed to undertake logging operation down to 3,000 metres, across any commodity in any environment, and with any wireline service.

The logging unit allows increased service offerings above conventional minerals based logging units, while providing cost savings over large conventional oil and gas logging units. The reduced foot print and improved maneuverability allow access into smaller drill sites, quicker setup and more efficient operations. The climate controlled logging compartment and full light setup allow 24 hour logging operations in any weather condition. The unit is built tough to Australian conditions.

The logging unit is built from the ground up with mine safety compliance fore front. Safety features incorporated in the build allow the unit to operate on any mine in Australia. Of particular note are the winch compartment ingress prevention barriers to prevent access to the winch compartment during logging operations and machinery guarding to AS4024.

The addition of a slew crane minimises manual handling when conducting open hole operations, and allows solo operations when conducting services from a wellhead. With a 5.1 metre vertical reach, a separate crane is rarely required for such services.

Draw works

- 2,000 metre depth capability
- PLC electric or hydraulic drive
- 3/16" 4 core wireline as standard
- Programmable rig in and rig out for solo logging operations manual cable spooling controlled by operator tension
- Automatic self-spooling
- Programmable winch run in hole and logging speed
- Automatic station mode for multi shot measurements
- Predetermined winch tension cut out
- Greater than 0.1% depth accuracy
- 6 core slip rings

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Downhole tension

(CSG)

Lifting devices

- Hydraulic crane with 330 degree slew angle
- 5.1 metre vertical reach and 4.0 metre outreach
- 1,250 Kg capacity
- Positive locking mechanisms and safety clips on all sheaves, pulleys and logging boom
- Lifting device working load limits to AS4991

Communications

- Programmable UHF or VHF radio and aerial
- Next G mobile phone and external aerial
- Iridium satellite phone
- In vehicle monitoring system (IVMS)

Safety features

- Driver and passenger airbags
- Machinery guarding to AS4024
- Ingress prevention barrier to winch compartment
- External roll over protective structure (ROPS) certification and manufacture as per ISO3471 and AS2294
- HIVIS colour white, with 50mm reflective stripping
- HIVIS ID signage
- Headlights always on and elevated tail lights
- Reversing alarm and rotating amber beacon
- Battery and starter isolators
- Emergency stops on wireline and lifting winches
- 240 Volt electrical system and RCDs test and tagged
- Workplace first aid and snake bite kit
- Hydrocarbon spill kit
- 4.5 Kg powder fire extinguisher



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(ZERO FORCE)





The Qteq Zero Force wireline logging unit combines a dedicated and purpose built logging van, mounted on a 4WD Fuso Canter chassis, and coupled with a hydraulic slew crane. This integration has been designed to undertake logging operations down to 2,000 metres, across any commodity, in any environment, and with all wireline services. The slew crane and innovative zero force sonde handler and transport mechanism eliminates manual handling when rigging in and out wireline tooling in open hole or rig based operations. With a 5.1 metre vertical reach, a separate crane is rarely required for solo well head operations.

The units are designed, engineered and manufactured in house at the companies Perth facilities, and are built from the ground up with mine and petroleum safety compliance fore front. Safety features incorporated in the new builds allow them to operate on any exploration or production site in the world.

Zero Force units allow increased service offerings above conventional minerals based logging units, while providing cost savings over large conventional oil and gas logging units. The reduced foot print and improved maneuverability allow access into smaller drill sites, quicker setup and more efficient logging operations. The climate controlled logging compartment and full light setup provide for 24 hour logging operations.

Zero Force is built tough to withstand Australian conditions.

Zero manual handling of wireline sondes
 Zero wireline pinch points

- Hydraulic swing down tyre carrier
- Enclosed and isolated winch and spooling mechanism from the operator
 - > 300% increase in logging cab floor space
- Large rear mounted window for unobstructed viewing of logging operation
- Modular design that can be fitted to a range of common light truck chassis

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(ZERO FORCE)

Draw works

- 2,000 metre depth capability
- PLC electric or hydraulic drive
- 3/16" 4 core wireline as standard
- Programmable rig in and rig out for solo logging operations – manual cable spooling controlled by operator tension
- Automatic self-spooling
- Programmable winch run in hole and logging speed
- · Automatic station mode for multi shot measurements
- · Predetermined winch tension cut out
- Greater than 0.1% depth accuracy
- 6 core slip rings
- Downhole tension

Communications

- Programmable UHF or VHF radio and aerial
- Next G / 4G mobile phone and external aerial
- Iridium satellite phone
- In vehicle monitoring system (IVMS)

Safety features

- Driver and passenger airbags
- Machinery guarding and ingress prevention to AS4024
- Roll over protective structure (ROPS)
- Completely enclosed and isolated winch and spooling system – no pinch points
- Winch, crane and vehicle interlocks
- HIVIS colour white and HIVIS ID signage
- Headlights always on and elevated tail lights
- Reversing alarm and rotating amber beacon
- Battery, starter and hydraulic isolators
- Emergency stops on all critical systems
- 240 Volt electrical system and RCDs
- IP66 switched power outlets
- Workplace first aid and snake bite kit
- 4.5 Kg powder fire extinguisher



Technical Specification Sheet

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Qteq

(LANDCRUISER)





Coal mine exploration and production

The Qteq wireline coal logging unit combines a current model Toyota Landcruiser Troop Carrier Turbo V8 diesel, with an integrated logging fit out. This integrated unit has been designed to undertake logging operations to 2,000 metres, across any commodity in any environment, and with any wireline service.

All wireline units are built in-house by Surtech System's design and fabrication specialists. The logging unit is built from the ground up with mine safety compliance fore front. Safety features incorporated in the build allow the unit to operate on any mine site in Australia. Of particular note is winch guarding to AS4024, and the density assistance device which effectively eliminates manual handling of the logging sondes.

The low foot print of the logging unit provides cost effectiveness over large conventional oil and gas logging units. The reduced foot print and improved manoeuvrability allow access into smaller drill sites, quicker setup and more efficient operations. The climate controlled logging compartment and full light setup allow 24 hour logging operations in any weather condition. The unit is built tough to Australian conditions.

For hostile access conditions, mud terrain tyres, front and rear air locking differentials or snow chains can be fitted. For extreme conditions, rubber track systems can be employed.

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(LANDCRUISER)

Draw works

- 2,000 metre depth capability ٠
- PLC control electric or hydraulic drive ٠
- ٠ 3/16" 4 core wireline as standard
- Automatic self-spooling
- Excellent low speed control
- Hardened measure wheel coupled to a high resolution optical encoder
- Greater than 0.1% depth accuracy
- 6 core slip rings
- Downhole tension





Lifting devices

- Density Assistance Device 6 Kg maximum operator exerted force to rig density in and out of hole
- Positive locking mechanisms and safety clips on all sheaves, pulleys and logging boom
- Lifting device working load limits to AS4991
- INROD sheave assembly for conducting INROD logging operations

Communications

- Programmable UHF or VHF radio and aerial
- Next G mobile phone and external aerial
- Iridium satellite phone
- In vehicle monitoring system (IVMS)

Safety features

- Driver and passenger airbags
- Machinery guarding to AS4024 winch and cargo barrier
- Internal roll over protective structure – certification to Queensland LH8 and Western Australia LK8
- HIVIS colour white, with 50mm reflective stripping • •
- **HIVIS ID signage**
- Headlights always on and elevated tail lights •
- Reversing alarm and rotating amber beacon
- Battery and starter isolators •
- Emergency stops on wireline and lifting winches
- 240 Volt electrical system and RCDs test and tagged
- Workplace first aid and snake bite kit
- Hydrocarbon spill kit
- 4.5 Kg powder fire extinguisher
- Dual tyre carrier



Technical Specification Sheet

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(OILFIELD UNIT) (DEMOUNTABLE SKID UNIT) DSU)



Coal Seam Gas | Oil and Gas | Hydro | Unconventional

Qteq's surface package catering for the Oil and Gas market consists of a full-service logging unit mounted on a dedicated logging truck chassis. The modular unit is fully demountable and configurable, allowing for a high degree of versatility and the running of all logging services.

The Demountable Skid Unit (DSU) is suitable for use on offshore locations and can be deployed to remote restricted access onshore locations that can be reached by a standard truck.

The truck is fitted with over 6,600 m of Slammer heptacable wireline for open hole logging, or optionally can be fitted with over 9,000 m of 9/32" OD monoconductor cable for cased hole work requiring pressure control equipment.

Qteq's DSU is ideally suited to service both the Australian open hole and cased hole land markets.

for such services.

Draw works

- 6,600 metre depth capability
- PLC hydraulic drive
- 0.46" 7 core wireline as standard
- Automatic self-spooling
- Predetermined winch tension cut out
- Greater than 0.1% depth accuracy
- 8 core slip rings

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Mobile Logging Platform

C)teq

(MLP)

The Qteq Mobile Logging Platform (MLP), offers unparalleled flexibility for the rigging up on a wellhead independently of a logging unit.

The trailer is a dual axle trailer with 2,300 Kg gross vehicle mass (GMV), which can be towed by any suitable 4WD vehicle. Up to 6 logging probes and tooling can be accommodated securely on board.

The trailer carries its own hydraulic slewing crane with an extension boom providing 9 metres of vertical reach to position the logging tools and or pressure control equipment above the wellhead.

Tools are lowered on an electric or hydraulic winch with a 2,500 metre depth capacity. All equipment on the trailer is powered by a 12 Volt system supplied via a dual battery bank, charged by solar panels, shore power or 12 Volt charger. Compared with conventional diesel powered generators, this system is lighter, silent, requires less maintenance and needs to refuelling or zone compliance. High power LED work lights are mounted on the trailer to permit independent night time operations

Technical Specification Sheet

Mobile Logging Platform

(MLP)

Draw works

- 3,000 metre depth capability
- Electric or hydraulic drive options
- 3/16" 4 core wireline as standard
- Automatic self-spooling
- Excellent low speed control
- Hardened measure wheel coupled to a high resolution optical encoder
- Greater than 0.1% depth accuracy
- 6 core slip rings
- Universal patch panel to accept third party acquisitions and telemetry systems



teq



Lifting devices

- Hydraulic crane with 325 degree slew angle
- 9.0 metre vertical reach and 6.8 metre outreach
- 700 Kg capacity intrinsically stable
- Extendable outriggers
- Positive locking mechanisms and safety clips on all sheaves, pulleys and lifting apparatus
- Lifting device working load limits to AS4991

Communications

- 3KVA 240 Volt invertor system
- Solar power provides for approximately 6 hours of operations using dual 12 Volt gel batteries
- 240 Volt shore power receptacle
- 12 Volt hydraulic system for crane and winch)

Safety features

- Crane position interlocks
- HIVIS colour white, with 50mm reflective stripping
- HIVIS ID signage
- High intensity LED work lights
- Reversing alarm and rotating amber beacon
- Emergency stops on wireline and lifting winches
- 240 Volt electrical system and RCDs test and tagged
- Dual tandem axle ensures intrinsic stability
- Electronic brake control
- 4.5 Kg powder fire extinguisher



Technical Specification Sheet

WIRELINE SERVICES

TECHNICAL SPECIFICATION SHEETS OPEN HOLE SERVICES

Dual Density Combination Sonde



(DDCS)

The Dual Density Combination Sonde (DDCS), is a density sonde comprising an active emitting chemical source, coupled with two high efficiency scintillation detectors to output formation bulk densities.

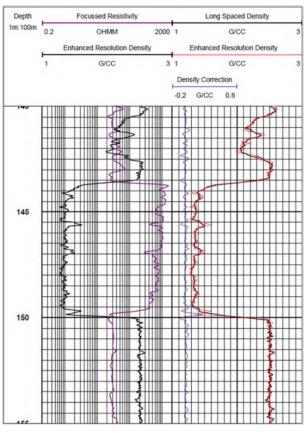
Density logging is based on measuring the attenuation of gamma rays between a source and detector as a result of Compton scattering. The gamma rays of Ceasium137 have sufficiently high energy to interact by Compton scattering, but not by pair production.

The short and long spaced scintillation detectors, measure resultant gamma rays from Compton scattering interactions that occur within the formation. The number of incident gamma rays is inversely proportional to the electron density of the formation. The electron density is proportional to the bulk formation density for most sedimentary rocks, where $2Z/A \sim 1$.

The density measurement responds to the average density of the material between the source and detector. To reduce uncertainty, borehole fluid is excluded by running the DDCS side-walled against the borehole wall. This focusses the collimated source and detectors into the formation.

A caliper mechanism that is in the same axis, but antipodal to the density measurement, sidewalls the sonde, as well as measures borehole diameter in a single axis.

The dual detector arrangement allows for borehole compensation, where the density response is corrected for the presence of mud cake and borehole rugosity. Borehole compensation is computed real time during logging.



Typical coal mining presentation

An enhanced vertical resolution density is computed by resolution matching the short and long space density responses. This improves the vertical resolution of the density, and is used for delineating thin beds, inter-bedding and plies, as well as improving accuracy of formation picks, and seam thickness.

The sonde includes a natural gamma and guard resistivity measurements, all in a package less than three metres long.

Applications

- Identifying formation lithology
- Determination of formation bulk density and density porosity
- Coal seam thickness, rank and quality
- Coal seam inter-bedding
- Coal ash analysis
- Ore and overburden tonnage
- Gas indication when run in conjunction with neutron porosity (NDRS)
- Shot optimisation in blast holes
- Identifying borehole rugosity, washouts and restrictions
- Through drill pipe and casing deployments for poor borehole conditions

Features

- Dual focussed detectors
- Short detector source spacings allow for excellent vertical resolution and thin bed delineation in laminated sequences
- Low activity Ceasium137 source minimises exposure and reduces radiation exclusion zones
- Field dressable caliper arms of different lengths, allow logging in a wide range of borehole diameters
- Short sonde length minimises amount of drilled rat hole
- Guard resistivity allows measurement of the flushed zone RXO
- High resolution acquisition at 9 m/min

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Llteq

(DDCS)

Georesources

- Coal mine exploration and production
- Coal seam gas
- Conventional Oil and Gas
- Unconventional Oil and Gas
- Base metals
- Industrial and metallic minerals
- Hydrogeology
- ٠ Geotechnics

Mechanical specifications

Outside Diameter (OD)	56 mm	2.2 in	
Length	280 cm	110.0 in	
Weight in Air	32 kg	72 lb	
Pressure Rating	18.0 MPa	2,500 psi	
Temperature Rating	85 °C	185 °F	
Min. Borehole Diameter	76 mm	3.0 in	
Max. Borehole Diameter	457 mm	18.0 in	
Logging Speed	9 m/min (540 m/hr)	30 ft/min (1,800 ft/hr)	
Borehole Fluid	Air, Water Based Mud (V	Air, Water Based Mud (WBM), Oil Based Mud (OBM)	
Sample Interval	User selectable (0.5, 1, 2, 10, 20 cm)		
Source	300 mCi Cs ¹³⁷		
Gamma Detector	22 x 102 mm Nal scintillation crystal		
Near Detector	22 x 32 mm Nal	scintillation crystal	
Far Detector	22 x 102 mm Na	22 x 102 mm Nal scintillation crystal	

Measurement specifications

	Gamma Ray	0 – 10,000 API	
	Short Spaced Density	0.50 – 3.50 g/cc	
Denne	Long Spaced Density	0.50 – 3.50 g/cc	
Range	Photoelectric	0 – 10 barns / electron	
	Guard Resistivity	0 - 40,000 ohmm	
	Caliper	0 – 457 mm (0 – 18.0 in)	
	Gamma Ray	+/- 5% of measured value	
	Short Spaced Density	+/- 0.02 g/cc	/1
A	Long Spaced Density	+/- 0.02 g/cc	/11
Accuracy	Photoelectric	+/- 0.2 barns / electron	
	Guard Resistivity	+/- 5% of measured value	· .
	Caliper	+/- 2.54 mm (0.10 in)	
	GRDS in GAPI	Gamma Ray	
	CALD in mm	Caliper	
	DENS in g/cc and cps	Short Spaced Density	
	DENL in g/cc and cps	Long Spaced Density	
	DENC in g/cc	Compensated Density	
Sonde Curves and Mnemonics	VDEN in g/cc	Vector Processed Density	
and whethomes	PE in b/e	Photoelectric	
	DCOR in g/cc	Density Correction	
	DPHI in % or v/v	Density Porosity	
	FEFR in ohm	Guard Resistivity	
qteq.com.au	HVOL / AVOL in m ³	Hole / Annular Volume	
info@qteq.com.au			ation Sheet



Lithology Density Tool



(LDP)

The Lithology Density Pad (LDP) assembles to the Pad Deployment Tool (PDT) mandrel section for logging operations. The PDT includes the caliper assembly. The LDP is run eccentrically.

The LDP uses two gamma detectors to record bulk density (LDEN) and photoelectric effect (PES/PEL) of the formation.

The difference between the measurements of the two detectors is used to correct the bulk density of the formation for mud cake and hole rugosity effects.

Bulk density is related to porosity and the photoelectric effect is related to lithology.

Two 1 microcurie Cs-137 pilot sources stabilise the high voltage spectrum.

Applications

- Open hole
- Fluid filled holes
- Fresh or salt muds

Specifications

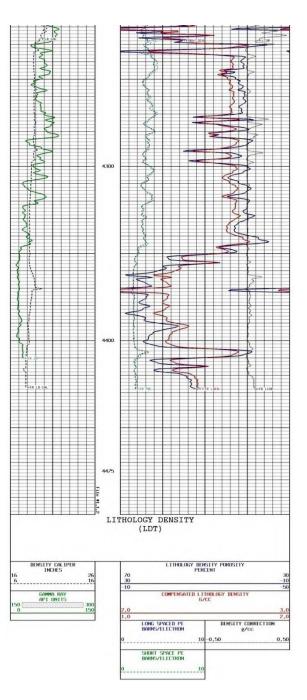
Pressure	20,000 psi	1,379 bar
Temperature	325 °F	163 °C
Tool length	9.72 ft	2.96 m
Tool O.D.	4.75 in	120 mm
Min. Borehole size	6.0 in	152 mm
Max. Borehole size	18.0 in	472 mm

Depth of investigation

LDEN	6-12 in	15-31 cm
PES	3.0 in	7.6 cm
PEL	6.0 in	15 cm

Vertical resolution

LDEN	8.0 in	20.3 cm
PES	4.0 in	10.2 cm
PEL	8.0 in	20.3 cm
Max. Logging Speed	50 ft/min	15 m/min



Typical presentation

Technical Specification Sheet

Dual Laterolog Tool

(DLT)

The DLT provides the deep resistivity measurement (LLD) and the shallow resistivity measurement (LLS).

Under normal conditions, the LLS will be the resultant of the flushed, invaded and transition zones. The LLD, although affected by the previous zones, will respond to mainly the virgin zone.

The accuracy of the measurement requires that the undisturbed formation has the largest contribution on the reading. Therefore, the mud resistivity must be low relative to the formation resistivity.

Applications

- Open hole and fluid filled
- DLT cannot be run in non-conductive mud, e.g. oil based mud
- DLT should be used in mud that is conductive relative to formation water (Rmf/Rw>2)

Specifications

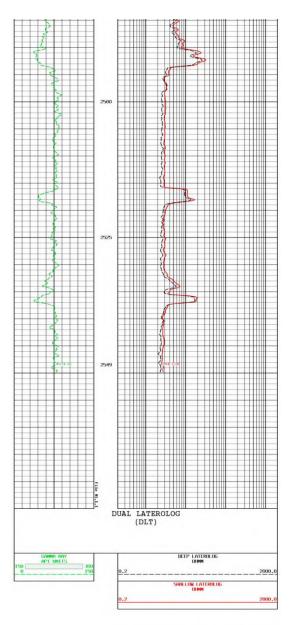
Pressure	20,000 psi	1,379 bar
Temperature	325 °F	163 °C
Tool length	14.86 ft	4.56 m
Tool O.D.	3.625 in	92 mm
Min. Borehole size	6.0 in	152 mm
Max. Borehole size	16.0 in	406 mm

Depth of investigation

LLD	72.0 in	183 cm
LLS	30.0 in	67 cm

Vertical resolution

LLD		26.0 in	66 cm
LLS		26.0 in	66 cm
Max. Lo	gging speed	60 ft/min	18.2 m/min



Jteq

Typical presentation

Technical Specification Sheet

(MST)

The micro Spherical tool provides a resistivity measurement in the invaded zone.

This is useful in distinguishing moveable hydrocarbons. When used in combination with a deep and medium reading resistivity tool, the MST can help estimate Rt.

Applications

- Open hole and fluid filled
- MST can be run in non-conductive mud, e.g. oil based mud or air filled holes

Specifications

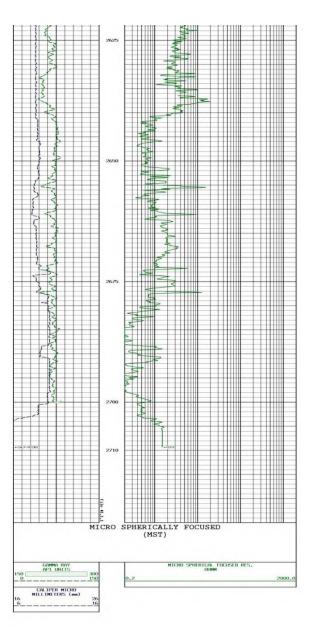
Pressure	20,000 psi	1,379 bar
Temperature	325 °F	163 °C
Tool length	9.66 ft	2.94 m
Tool O.D. (MSFL pad)	5.25 in	133 mm
Tool O.D. (Micro pad)	4.50 in	11.4 cm
Min. Borehole size	6.0 in	152 mm
Max. Borehole size	22.0 in	558 mm

Depth of investigation

MSFL	4.0 in	10.2 cm

Vertical resolution

MSFL	2.0 in	5.1 cm
Max. Logging speed	45 ft/min	13.7 m/min



LJteq

Typical presentation

Technical Specification Sheet

Phased Induction / SFL Tool



(PIT)

The PIT measures both R and X induction signals for deep and medium induction. Spontaneous potential (SP), Temperature and SFL are also measured.

This tool improves the temperature stability of the sonde.

Improved sensitivity of electronics provides a much greater counts to mmho ratio.

By measuring the R and X signals, processing will provide thin-bed enhancements and better "skin effect" correction

Applications

- Open hole
- Water filled
- Fresh mud
- Oil based muds
- SFL and SP cannot be run in non-conductive fluids, e.g. oil based mud or air filled holes

Specifications

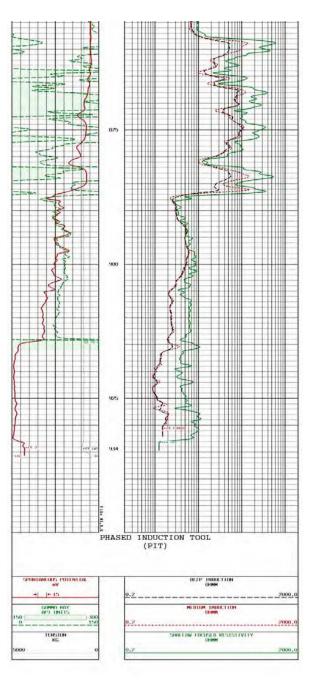
Pressure	20,000 psi	1,379 bar
Temperature	325 °F	163 °C
Tool length	21.48 ft	6.55 m
Tool O.D.	3.625 in	92 mm
Min. Borehole size	5.5 in	140 mm
Max. Borehole size	22.0 in	560 mm

Depth of investigation

ILD	62 in	158 cm
ILM	27 in	69 cm
SFL	13 in	33 cm

Vertical resolution

ILD	60 in	152 cm
ILM	24 in	61 cm
SFL	18 in	46 cm
Max. Logging speed	120 ft/min	36 m/min



Typical presentation

Technical Specification Sheet

Neutron Deviation Resistivity Sonde

C,teq

(NDRS)

The Neutron Deviation Resistivity Sonde (NDRS), is a thermal neutron sonde, comprising an active emitting chemical source, coupled with a He3 proportional detector to output neutron porosity and neutron API in fluid filled boreholes.

The NDRS also measures formation resistivity, producing both deep (64"), and shallow (16"), normal resistivity measurements. The focussed resistivity (FEFR), from the DDCS provides a third, shallower (micro) resistivity measurement.

Each of the three resistivities has a different depth of investigation, and when used in conjunction, an invasion profile of the borehole fluid is produced. Understanding the invasion profile allows calculation of fluid saturation and Rt determinations.

A spontaneous potential measurement, qualitatively identifies zones of permeability.

The NDRS includes a natural gamma ray measurement, where the gamma ray circuit, allows for very high count rates often encountered in uranium and other radiometric investigations.

A precision 3 axis magnetometer and accelerometer package provides continuous surface read out of borehole azimuth and inclination.

Deviation analysis using the minimum curvature method and azimuth and inclination data, determines borehole trajectory in 3D space. The minimum curvature method is recognised as one of the most accurate calculation methods.

The NDRS can determine geothermal gradients, formation temperature, and temperature measurements for production logging. The NDRS measures temperature with a platinum thermometer that is exposed to the borehole fluid.

Depth Focussed Resistivity Long Spaced Density 1m:100m 0.2 OHMM 2000 1 G/CC Enhanced Resolution Density Enhanced Resolution Density G/CC 3 1 G/CC Density Correction -0.2 G/CC 0.8 145 150

Typical coal mining presentation

Applications

- Identifying formation lithology
- Neutron porosity
- Permeability and fluid saturation
- Determining setting depths for completions
- Gas detection when run in conjunction with density log
- Delineating uranium radiometric ore bodies a calibrated uranium ore grade can be calculated
- · Geothermal gradients and formation temperatures
- Production logging temperature surveys
- Borehole deviation analysis
- Through drill pipe and casing deployments for poor borehole conditions

Features

- 10 parameters in a single logging pass
- Low gamma dead time circuit allows very high count rates
- He³ proportional neutron detector
- Low activity Americium241Berylium source minimises exposure and reduces exclusion zones
- A blanking sub can be run when neutron data is not required or poor borehole conditions preclude its use
- Complete resistivity and neutron package for formation fluid saturation
- Spontaneous potential for permeability indication
- High resolution platinum thermometer

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(NDRS)

Georesources

- Coal mine exploration and production
- Coal seam gas
- Conventional Oil and Gas
- Unconventional Oil and Gas
- Base metals
- Industrial and metallic minerals
- Hydrogeology
- Uranium exploration
- In situ leach (borehole mining)

Mechanical specifications

Outside Diameter (OD)	53 mm	2.1 in		
Length	237 cm	94 in		
Weight in Air	15 kg	33 lb		
Pressure Rating	27.5 bar	4,000 psi		
Temperature Rating	80 °C	176 °F		
Min. Borehole Diameter	76 mm	3.0 in		
Max. Borehole Diameter	355 mm	14.0 in		
Logging Speed	9 m/min (540 m/hr)	30 ft/min (1,800 ft/hr)		
Borehole Fluid	Air, Water Based Mud (W	/BM), Oil Based Mud (OBM)		
Sample Interval	User Selectable ((0.5, 1, 2, 10, 20 cm)		
Source	1 Ci /	Ci Am ²⁴¹ Be		
Gamma Detector	22 x 102 mm Na	Nal scintillation crystal		
Neutron Detector	25 x 152 mm He ³	proportional counter		

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(NDRS)

Measurement specifications

	Gamma Ray	0 – 400,000 API			
	Neutron Porosity	0 – 100 %			
	Neutron API	0 – 20,000 API			
_	Resistivity – 16, 64, Lat	0 – 2,000 ohmm			
Range	Single Point Resistivity	0 – 2,000 ohm			
	Spontaneous Potential	0400 - +400 mV			
	Temperature	0 – 70 °C (32 – 158 °F)			
	Deviation	0 – 360° azimuth, 0 – 50° tilt			
	Gamma Ray	+/- 5% of measured value			
	Neutron	+/- 5% of measured value			
_	Resistivity (all)	+/- 5% of measured value			
Accuracy	Temperature	+/-/ 0.5 °C			
		+/- 0.5° azimuth			
	Deviation	+/- 0.2° borehole tilt			
	GRNS in GAPI	Gamma Ray			
	TEMP in DEG °C or °F	Borehole Temperature			
	DTMP in DEG °C or °F	Differential Temperature			
	SP in mV	Spontaneous Potential			
	16RN in ohm	16 in Normal Resistivity			
Sonde Curves	64RN in ohm	64 in Normal Resistivity			
and Mnemonics	RLAT in ohm	Lateral Resistivity			
	SPR in ohm	Single Point Resistivity			
	NPHI in % or v/v	Neutron Porosity			
	NAPI in API	Neutron API			
	TILT, AZIT in DEG°	Borehole Tilt and Azimuth			
	Various in m, DEG°	Deviation Analysis			

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Compensated Neutron Tool



(CNP)

The Compensated Neutron Tool Pad (CNP) assembles to the Pad Deployment Tool (PDT) mandrel section for logging operations. The PDT includes the caliper assembly. The CNP is run eccentrically.

The CNP uses two Helium 3 detectors to measure the ratio of thermal neutrons at each detector.

The ration is corrected for hole size and a porosity is computed for a selected lithology.

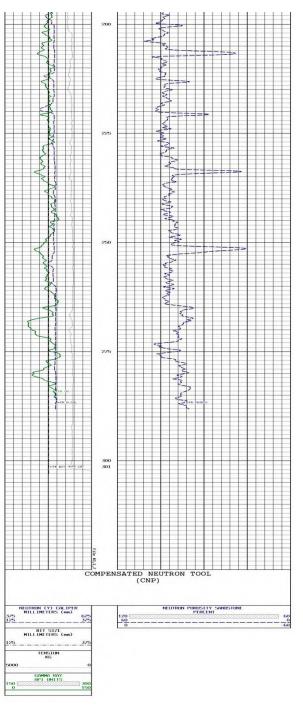
In addition, a caliper is recorded and used for the hole size correction.

Applications

- Open hole
- Cased hole
- Fluid filled holes
- Fresh or salt muds

Specifications

Pressure	20,000 psi 1,379 bar				
Temperature	325 °F	163 °C			
Tool length	9.72 ft	2.96 m			
Tool O.D.	4.75 in	120 mm			
Min. Borehole size	6.0 in	152 mm			
Max. Borehole size	18.0 in	472 mm			
Depth of investigat PHIN Vertical resolution PHIN	ion 6-12 in 10.0 in	15-31 cm 25.4			
Max. Logging speed	50 ft/min	15 m/min			



Typical presentation

Technical Specification Sheet

Formation Sonic Sonde

C)teq

(FSS)

The Formation Sonic Sonde (FSS), produces compressional, shear and stoneley wave slownesses for broad applications such as petrophysical analysis borehole geomechanics, and seismic applications. The complete waveform is digitally recorded, allowing for post processing and advanced interpretation products.

The FSS comprises a piezoelectric transmitter and multiple omni directional receivers, separated by an acoustic isolator to disengage direct transmission along the sonde body.

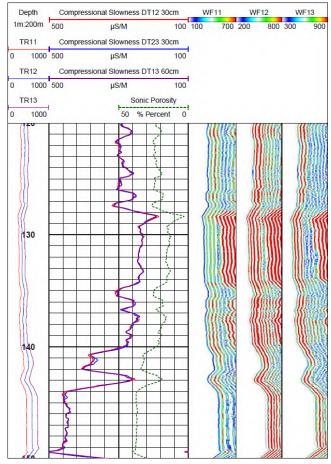
Available receiver spacing configurations are:

- 30, 60, 90, 120 cm
- 60, 90, 120 cm
- 90, 120 cm

First arrival transit times are determined real time by a user set threshold and zero crossing algorithm for each receiver. As the FSS records each complete receiver waveform, post logging repicking of first arrivals is possible through intervals of bad hole conditions, where rugosity and washouts are present. Sonic repicking is also used for shallow unconsolidated formations such as alluvials, sands and marine muds.

Compressional slowness is output for each combination of transit time pairings.

Shear and stoneley slowness are derived by slowness time coherence processing. Shear data can be extracted from the waveform in formations that are faster than the borehole fluid: DtShear < DtFluid 620 µsec/m.



Typical presentation

A continuous log of mechanical rock strength properties is able to be calculated when both compressional and shear data is available, along with formation bulk density.

The sonde also includes a natural gamma ray measurement for depth correlation.

Applications

- Compressional, shear and stoneley wave slowness
- Sonic porosity (primary)
- Estimate secondary porosity $\phi_{Secondary} = \phi_{Total} \phi_{Sonic}$
- Formation lithology
- Mechanical rock strength properties
- Uniaxial Compressive Strength (UCS) for mining applications
- Pore pressure prediction and sanding potential
- Drilling stability modelling
- Waveform fracture detection
- Seismic time to depth correlation
- Amplitude variation with offset calibration
- Synthetic seismograms
- Cement bond and integrity evaluation

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Formation Sonic Sonde

(FSS)

Features

- 24 kHz piezoelectric transmitter
- Piezoelectric near and far omni receivers
- Selectable sample intervals of 1, 2, 10, or 20 cm
- 4 msec RX recording window
- Records complete waveform
- VDL, amplitude and transit time for quantitative and qualitative evaluation of the cement bond quality
- Fixed or sliding gate picking of E3 arrival
- Short sonde length
- Slim OD package
- Gamma ray and CCL measurements for depth correlation
- Basket centralisers maintain tool centralisation through all borehole sizes

Georesources

- Coal mine exploration and production
- Coal seam gas
- Conventional Oil and Gas
- Unconventional Oil and Gas
- Base metals
- Industrial and metallic minerals
- Hydrogeology
- Geotechnics

Mechanical specifications

Outside Diameter (OD)	51 mm	2.0 in		
Length	354 cm	139 in		
Weight in Air	22 kg	50 lb		
Pressure Rating	18.0 MPa	2,500 psi		
Temperature Rating	85 °C	185 °F		
Min. Borehole Diameter	76 mm	3.0 in		
Max. Borehole Diameter	318 mm	12.5 in		
Logging Speed	4.5 – 9 m/mi	n 15 – 30 ft/min		
Borehole Fluid	Water Based Mud (WBM), Oil Based Mud (OBM)			
Sample Interval		User Selectable (1, 2, 10, 20 cm)		
Gamma Detector	22 x 102 mm Nal scintillation crystal			
Transmitter	Monopole Piezoelectric @ 24 kHz			
Receivers Omni	Piezoelec	electric, 2 – 4 RX @ 30, 60, 90, 120 cm spacings		
First Arrival Detection	Threshold Zero Crossing			

Technical Specification Sheet

Llteq

Formation Sonic Sonde



(FSS)

Measurement specifications

	Gamma Ray	0 – 10,000 API
	Receiver Time Domain	0 – 4,096 µsec
	Receiver Amplitude	-2,500 mV – 2,500 mV
Range	Compress Slowposs	130 – 820 µsec
	Compress Slowness	(40 – 250 µsec)
	Shear Slowness	245 – 620 µsec
	Shear Slowness	(75 – 189 µsec)
	Gamma Ray	+/- 5% of measured value
Accuracy	Receiver Time Domain	+/- 0.5 μsec
Accuracy	Receiver Amplitude	+/- 2% of measure value
	Compress Slowness	+/- 1.0 µsec
	GRDT in GAPI	Gamma Ray
	TR11 in µsec	TX1 – RX1 Transit Time
	TR12 in µsec	TX1 – RX2 Transit Time
	TR13 in µsec	TX1 – RX3 Transit Time
	DT13 in µs/m or µs/ft	Compressional Slowness
Sonde Curves	DT12 in µs/m or µs/ft	Compressional Slowness
and Mnemonics	DT23 in µs/m or µs/ft	Compressional Slowness
	SPHI in % or v/v	Sonic Porosity
	UCS in MPA	Uniaxial Comp Strength
	WF11 array (µsec, mV)	TX1 – RX1 Waveform
	WF12 array (µsec, mV)	TX1 – RX2 Waveform
	WF13 array (µsec, mV)	TX1 – RX3 Waveform

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Compensated Sonic Tool

(CST)

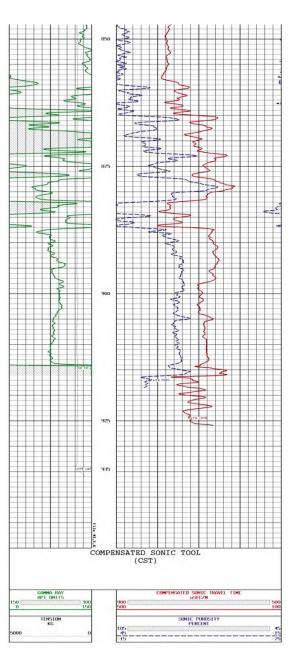
The Compensated Sonic Tool (CST) is a two transmitter, two receiver design with 3' and 5' spacing. The tool provides borehole compensated travel time (DT), sonic amplitude and integrated transit time (ITT). Digital waveform recordings is available.

Applications

- Open hole
- Cased hole
- Fluid filled holes
- Fresh or salt muds

Specifications

Pressure	20,000 psi	1,379 bar
Temperature	325 °F	163 ℃
Tool length	13.9 ft	4.24 m
Tool O.D.	3.625 in	92 mm
Min. Borehole size	4.5 in	114 mm
Max. Borehole size	22.0 in	560 mm
Depth of investigati	on	
Delta time	1.5 in	3.81 cm
Vertical resolution		
Delta time	2 ft	61 cm
Max. Logging Speed	60 ft/min	18.2 m/min



Qteq

Typical presentation

Technical Specification Sheet

Spectral Gamma Ray



(SGR)

The Spectral Gamma Ray probe measures the total gamma counts in API as well as the full energy spectrum of the natural gamma radiations emitted naturally from within the formations.

A Full Spectrum Analysis (FSA)1 is performed on the recorded energy spectra. The FSA derives in real time the concentration of the three main radioisotopes 40K, 212 Th and 238U and thus provides insight into the mineral composition of the formations.

The QL40 SGR is equipped with a scintillation BGO (Bismuth Germanium Oxyde) crystal. The BGO crystal has a high scintillation efficiency, good energy resolution and is mechanically strong.

The QL40-SGR is supplied as an inline sub. It can be combined with other logging tools of the QL40 (Quick Link) product line or can be operated as a standalone tool. It is compatible with Matrix, BBOX and ALTlogger acquisition systems.

Principles of measurement

The Spectral Gamma Ray is equipped with a BGO scintillation crystal. When exposed to gamma rays, the BGO crystal emits light as a function of the gamma ray energies. The pulses of light are amplified by a photomultiplier tube and converted into electrical pulses which are distributed into 256 discrete energy channels.

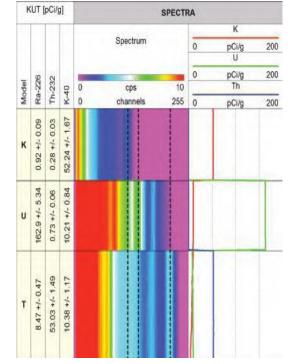
Gamma ray analysis is performed in two steps. First spectrum stabilisation will be performed: each multichannel spectrum in the data set will be converted to a spectrum having all count peaks at the corresponding energy position. This process implies a close comparison with the reference spectra obtained during the calibration process of the spectral gamma tool at the Medusa calibration facility.

In a second step the stabilised spectrum will be convoluted into concentrations of naturally occurring radionuclides (40K, 238U, 232Th) or other man-made nuclides like 137Cs or 60Co. Corrections taking borehole diameter, rock density, casing type and thickness, tool position and borehole fluid conditions into account can be applied.

Applications

- Recognition of radioactive materials
- Contamination studies
- Lithology characterisation
- Well to well correlation
- Sedimentology differentiation of facies and depositional environment
- Mineral composition

Time	Spectrum	Chi2		к			U			Th		K-Error			U-Error		Th-Error	
1m:5000s	0 cps 34.5035 0 channels 255	0.6	1.1	0 %	5	0	ppm	40	0 р	pm 40	0.3	96	0.5	1	ppm 1.	6 1	ppm	4
		Spectrum - A1		K - Co	жт		U - Corr		Th	- Corr								
0.00		0.66	0.67	0 %	5	0	ppm	40	о р	ipm 40								
0.00			-	3			3		5		-	5			2		-	4
100.00		2	-	2					4						~		2	~
		13	-	}			8		55			2	_	_		-	<	5
200.00		2	-	$\sum_{i=1}^{n}$		-	\$		N			2			2	-	~	3
300.00		3	~	2			3		3			25	-		5			5
		0.66	0.67	0 %	5	0	ppm	40	0 p	ipm 40								
		Spectrum - A1		K - Co	OFT		U - Corr		Th	- Corr								
1m:5000s	0 channels 255 0 cps 34.5035	0.6	1.1	0 %	5	0	ppm	40	0 р	ipm 40	0.3	%	0.5	1	ppm 1.	6 1	ppm	4
Time	Spectrum	Chi2	- 1	к			U			Th		K-Error			U-Error		Th-Error	



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Spectral Gamma Ray

(SGR)

Features & Benefits

- 256 channels gamma ray energy spectrum
- Stabilised spectrum
- Total gamma counts
- Concentration of radioisotopes [Bq/kg or ppm)
- Concentration Error of radioisotopes (Bq/kg or ppm)

Operating conditions

- Open or cased borehole
- Water filled or dry borehole

Mechanical specifications

Diameter	40 mm	1.6 in		
Length	93 cm	36.6 in		
Weight	6 kg	13 lb		
Pressure Rating	200 bar	2,900 psi		
Temperature Rating	70 °C	158 °F		
Sensor	BGO crystal – 2.22 cm x 10.16 cm (0.875 x 4.00 in)			

Measurement specifications

Measurement Point	0.21 m (8.29 in) from bottom
Measurement Range	up to 3 MeV
Perspected Perspe	

¹ The Full Spectrum Analysis (FSA) is developed by Medusa Systems BV in collaboration with the Nuclear Physics Institute of the University of Groningen (Netherlands)





Spectral Gamma Ray Telemetry with Rm Tool (SGRT)



The SGRT-FA measures total natural gamma ray response and volumetric concentrations of potassium, uranium, andthorium. The tool acts as a downhole telemetry controller for all TTI tools.

The SGRT-FA must always be run at the top of the tool stack unless accompanied by an Auxiliary Measurement Tool, in which the AMT must be at the top of the tool stack.

Real time mud resistivity and borehole temperature measurements provide improved borehole environment corrections.

Applications

- Open hole
- Cased hole
- Fluid filled
- Air filled

Specifications

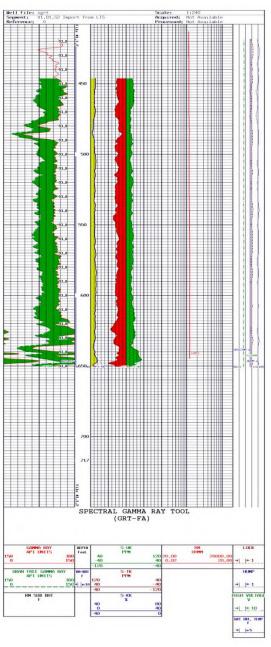
Pressure	20,000 psi	1,379 bar
Temperature	325 °F	163 °C
Tool length	7.6 ft	2.32 m
Tool O.D.	3.625 in	92 mm
Min. Borehole size	5.5 in	140 mm
Max. Borehole size	22.0 in	560 mm

Depth of investigation

GR	6-12 in	150-300 mm

Vertical resolution

GR	1 ft	304.8 mm
Max. Logging speed	60 ft/min	18.2 m/min



Typical presentation

Technical Specification Sheet

Borehole Magnetic Resonance

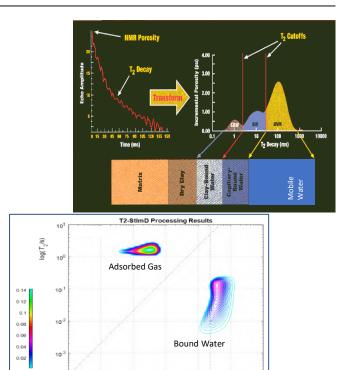
Cteq

(BMR)

Borehole Magnetic Resonance (BMR) logging makes use of strong permanent magnets and a weak oscillating magnetic field from precisely timed bursts of electromagnetic (EM) energy at specific radio frequencies (RF). Between these pulses an antenna is used to detect decaying spin-echo signals from hydrogen nuclei.

These signals are processed to characterize the pore structure of rocks in much the same way as Magnetic Resonance Imaging (MRI) is used to interrogate the interior structure of the human body. BMR is specifically tuned to sense pore network fluids only, enabling precise determination of rock total porosity, mobile fluid content (specific yield), bound fluid content (specific retention) and permeability (can be converted to hydraulic conductivity). BMR can also distinguish fluid types, with advanced analysis techniques developed to quantify both adsorbed gas content and free gas content of coals.

This unique measurement of formation porosity and more eliminates the need for radioactive sources and is independent of lithology.



log(D_{eff}/ m

Applications

- Mapping total porosity, specific yield and dry bulk density in iron ore deposits to determine blend for feed stock to the crusher, quantify resource and pick open/closed fractures (in combination with ATV/OTV).
- Developing dewatering strategies in and around underground and open pit mines.
- Mapping aquifer hydrogeology to guide development of comprehensive groundwater management strategies.
- Mapping brine hydrogeology to determine the economic viability and shaping development strategy of brine mining operations.
- Map coal seam gas content and permeability distribution for optimization of gas production for both coal and CSG.

Features & Benefits

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While BMR has been used routinely in the oil and gas logging industry for decades, uptake by other industries has been hindered by BMR tool size and cost of the logging service. Qteq have addressed this capability gap through development of an advanced miniaturized, slim borehole Magnetic Resonance (BMR) logging tool.

- Advanced BMR pulse sequences and signal processing techniques enable pore structure and mobile water content to be determined with a high degree of precision and accuracy.
- Permeability is calculated using standard Timur-Coates or SDR equations
- Real time processing of data coupled with transmission back to the office enable near real time decisions to be
 made by the subsurface team
- High Signal to Noise Ratio (SNR) enables a faster logging speed than conventional BMR tools with speeds up to 120 m/hr.
- The BMR logging tool can be run centered in open-hole, fiberglass or PVC lined boreholes.

Qteq

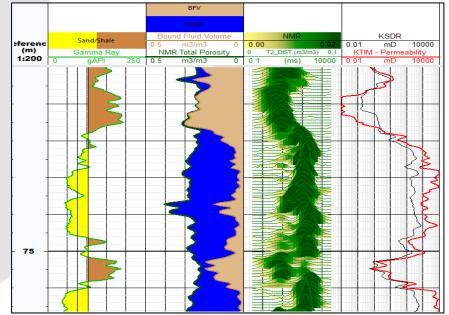
(BMR)

Specifications

To fit inside the typically small diameter boreholes drilled to explore and delineate mineral deposits, development of the BMR logging tool necessitated a high degree of hardware miniaturisation and implementation. Challenges were successfully overcome through pioneering applied research, innovative design and a number of inventive steps. As a consequence of these breakthrough achievements, BMR is able to deliver high quality, high resolution data, on a wide range of geophysical pore-related parameters.

	QL40-BMR-60		QL40-BMR-90			
Physical Dimensions						
Tool Diameter	60 mm	2 ¾ in	90	mm	3 5/	∕₃ in
Tool Length	2.01 m	6.6 ft	2.16 m		7.1 ft	
Operating Pressure	200 bar	2,900 psi	200 bar		2,900 psi	
Operating Temperature	100 °C	212 °F	100 °C		212 °F	
NMR Field						
Diameter of Investigation*	230 mm	9 ¹ / ₁₆ in	360 mm	14 1⁄8 in	220 mm	8 5/ ₈ in
Vertical Sensor Aperture	11.5 cm	4 1⁄2 in	23.8 cm	9 3/8 in	9.8 cm	3 7/8 in
Echo Spacing (TE)	450 µs		600 µs		250) µs
Wait Time (TW)	Multi		Multi			
T2 Distribution	0.5 x TE – 5 seconds		0.5 x TE – 5 seconds			
Porosity Range	0 – 100 pu		0 – 100 pu			
Total Porosity Precision	2 pu – 2 level averaging		2 pu – 3 level averaging			
Well Parameters						
Hole Sizes 75 – 186 mm			122 – 312 mm 122 – 176		76 mm	
	3 – 7 ¼ in	4 3⁄4 -	12 ¼ in	4 3/4 -	6 % in	
Hole Condition	Open hole, Fiberglass or PVC casing					





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Magnetic Susceptibility Sonde

lea

(MSS)

The Magnetic Susceptibility Sonde (MSS), is a slim hole mining tool designed to measure the magnetic susceptibility of the formation.

Magnetic susceptibility is a dimensionless proportionality constant that indicates the degree of magnetisation of a material in response to an applied magnetic field.

The tool combines a natural gamma sensor, magnetic susceptibility, and a magnetic deviation/azimuth package.

It can be run in a standard 10 cm depth sampling rate as well as a high resolution 1 cm depth sampling rate.

The tool can be operated in both air-filled and fluid-filled boreholes.

Applications

- Identifying magnetic zones
- Ore grade indication
- Lithology identification
- Borehole trajectory
- Commodities
- Base metals
- Industrial and metallic minerals

Features

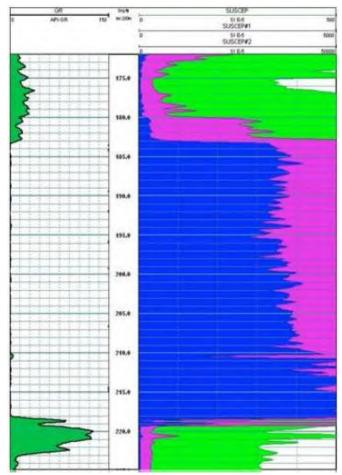
- Natural Gamma: 2.2 x 10.2 cm (0.875 x 4 in) Scintillation Crystal Offset: 91.4 cm (36 in)
- Magnetic Susceptibility: Dual-focused coils, 1.44 kHz operating frequency 10.2 cm (4 in) resolution vertically and horizontally Offset: 186 cm (73.2 in)
- Slant Angle and Azimuth Measurements: 3-axis magnetometer 2-axis inclinometer Offset: 34.3 cm (13.5 in)

Georesources

- Base metals
- Industrial and metallic minerals

Mechanical specifications

Outside Diameter (OD)	41 mm	1.6 in	
Length	2100 mm	82.67 in	
Weight in Air	18 kg	40 lb	
Pressure Rating	20.0 MPa	3000 psi	
Temperature Rating	70 °C	158 °F	
Min. Borehole Diameter	75 mm	3.0 in	
Max. Borehole Diame <mark>ter</mark>	310 mm	12.2.0 in	
Logging Speed	9 m/min (540 m/hr)	30 ft/min (1,800 ft/hr)	
Sample Interval	User selectable (0	User selectable (0.5, 1, 2, 10, 20 cm)	





(MSS)

Measurement specifications

Damas	Gamma Ray	0 – 10,000 API
Range	Susceptibility	0 – 439,00 CPS
	Gamma Ray	+/- 5% of measured value
Accuracy	Susceptibility	+/- 5% of measured value
	GRDS in GAPI	Gamma Ray
Sonde Curves and Mnemonics	TILT, AZIT in DEG°	Borehole Tilt and Azimuth
	SUSCEP	Susceptibility



Acoustic Formation Imager

Cteq

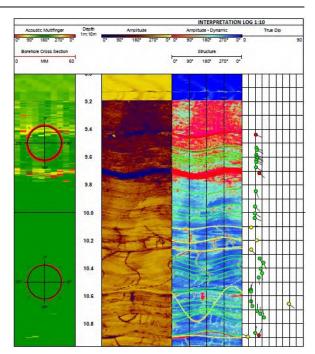
(AFI)

The Acoustic Formation Imager (AFI), comprises a focused ultrasonic transducer and rotating reflector lens, coupled to a precision 3 axis magnetometer and accelerometer package to provide orientation.

The reflector lens is rotated up to 20 revolutions per second by a very accurate stepper motor and position resolver. During each rotation, the reflector stops a definable number of time (90, 180, 270 or 360), and the transducer outputs a constant power ultrasonic wavetrain. The transducer then received the reflected wavetrain from the borehole wall. Both the transit time and reflection energy (amplitude) are recorded.

An amplitude map is produced from the received amplitude of the ultrasonic wavetrain from each shot. Changes in amplitude are a result of a change in acoustic impedance of a formation or feature. Features such as depositional bedding, open and closed fractures, break out and washouts are observed as sinusoidal features. Interpretation of these features through manual and automated "picking" algorithms and classification, result in orientated dip magnitude, dip azimuth and aperture width.

This information is further value added by stratigraphic and statistical analysis.



AFI example interpretation log

A fluid slowness transform converts the transit time map to a high resolution radius map with up to 360 acoustic caliper measurements. This radius map is applied to the amplitude and optical formation imager (OFI) optical maps to produce true 3D virtual core projections. An acoustic multifinger caliper, along with borehole cross sections, are output to aid with borehole geometric interpretation.

The AFI works in all drilling fluids, and with all fluid additives. The AFI does not require clear well fluids like the OFI.

Applications

- Stratigraphic characterisation of bedding, fractures, washouts, break out and other features, and their orientation
- Sedimentary features
- Visualisation of complex structures
- Thin bed evaluation
- Coal structure analysis cleat and joint system
- Structural interpretation
- Rock texture analysis
- Virtual coring substitution for core loss
- Geomechanical reservoir analysis
- Borehole geometry
- Borehole deviation analysis
- Evaluation of secondary porosity in carbonates and igneous reservoirs vuggy fraction
- Break out analysis
- Casing and tubular integrity investigation, quantifying wear, damage, corrosion and restrictions to casing, tubing, screens and production strings

Features

- Focussed 1.5 MHz piezoelectric transducer
- Fast logging speeds of up to 6 m/min
- Able to resolve features down to 1.0 mm
- Continuous circumferential amplitude, transit time and radius maps over the entire wellbore
- Wideband transducer allows measurements in 60 508 mm boreholes
- Precision 3 axis magnetometer and accelerometer package referenced to the transducer for orientation
- Non-magnetic basket centralisers maintain tool centralisation through all borehole sizes
- Many interpretation products
- Optional roller centralisers are available where telescoped casing strings are present

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Acoustic Formation Imager



(AFI)

Georesources

- Coal mine exploration and production
- Coal seam gas
- Conventional Oil and Gas
- Unconventional Oil and Gas
- Base metals
- Industrial and metallic minerals
- Hydrogeology
- Geotechnics

Mechanical specifications

Outside Diameter (OD)	42 mm	1.7 in
Length	207 cm	81.0 in
Weight in Air	10 kg	22 lb
Pressure Rating	20.0 MPa	2,900 psi
Temperature Rating	70 °C	158 °F
Min. Borehole Diameter	60 mm	2.4 in
Max. Borehole Diameter	508 mm	20.0 in
Logging Speed	4 – 7 m/min	7 - 23 ft/min
Borehole Fluid	Fresh and Saline Water, Water Based Mud (WBM), Oil Based Mud (OBM)	
Sample Interval	Unlimited, determined by logging speed	
Azimuthal Resolution	User selectable (90, 180, 270, 360 shots per revolution)	
Transducers	Piezoelectric, Composite Focussed 1.0 in	
Transducer Frequency	1.5 MHz	

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(AFI)

Measurement specifications

	Gamma Ray	0 – 10,000 API	
D	Caliper	60 – 508 mm (0 – 20 in)	
Range		0 – 360° azimuth	
	Deviation	0 – 180° borehole tilt	
	Gamma Ray	+/- 5% of measured value	
	Calliper	+/- 0.05 mm (0.002 in)	
•	Transit Time	+/0 0.1 µsec	
Accuracy	Amplitude	+/- 1.0 amplitude units	
	Deviation	+/- 0.5° azimuth	
	Deviation	+/- 0.2° borehole tilt	
	User selectable (Magnetic	North, True North, High Side	
luce as Orientetica	Magnetic North – Open Hole		
Image Orientation	True North – Open Hole (default)		
	High Side – Magnetic interference (oriented with gyro)		
	GRAF in GAPI	Gamma Ray	
	AMAP (deg°, mV)	Amplitude Map Array	
	TMAP (deg°, μs)	Transit Time Map Array	
	RMAP (deg°, mm)	Radius Map Array	
	AFMC (deg°, mm)	Acoustic Multifinger	
Sonde Curves	TILT, AZIT in DEG°	Borehole Tilt and Azimuth	
and Mnemonics	FMAG in nT	Magnetic Field Magnitude	
	AMAG in g	Acceleration Magnitude	
	RBHS in deg [°]	Relative Bearing High Side	
	XMAG, YMAP, ZMAG	3 Axis Magnetometer	
	XACC, YACC, ZACC	3 Axis Accelometer	

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Optical Formation Imager



(OFI)

The Optical Formation Imager (OFI), comprises a very high resolution CMOS image sensor, coupled to a precision ground glass circle view lens. This provides a continuous optical assessment of the borehole wall, able to resolve features down to 0.5 mm.

The 360 deg° circle view lens provides a focused horizontal image disc perpendicular to the sonde axis, approximately 0.5 mm in height. Each "image disc" is stacked to provide a continuous circumferential panorama of the wellbore.

The image sensor is aligned with a precision 3 axis magnetometer and accelerometer package to provide an orientated image in all destructive and core drilled open holes, as well as in steel, PVC, glass reinforced epoxy (GRP), or fibre reinforced polymer (FRP) casings. Gyroscopic deviation can be used for orientation in steel casing, and through formations of magnetic interference.

The OFI does not look downhole like conventional CCTV devices, but looks "sideways", offering unparalleled wellbore coverage, resolution and interpretation potential.

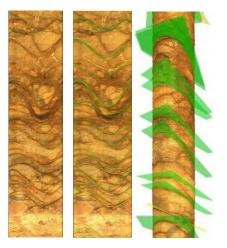
Applications

- Stratigraphic characterisation of bedding, fractures, washouts, break out and other features, and their orientation
- Sedimentary features
- Coal structure analysis cleat and joint system
- Structural interpretation
- Virtual coring substitution for core loss
- · Subterranean fauna assessment of troglofauna and stygofauna species
- Borehole deviation analysis
- Casing and tubular integrity investigation, quantifying wear, damage, corrosion and restrictions to casing, tubing, screens and production strings

Features

- Very high resolution 1,280 x 1,024 pixel CMOS image sensor and 360 deg° circle view lens
- Continuous circumferential 3D panorama
- Fast logging speeds of up to 9 m/min
- Both sensor and les are fixed, with no requirement for rotation by a motor assembly
- Precision 3 axis magnetometer and accelerometer package referenced to the image sensor for orientation
- High efficiency white LEDs provide excellent illumination, even in turbid fluids
- Light output controlled real time by 20 user selectable settings in software
- Non-magnetic basket centralisers maintain tool centralisation through all borehole sizes
- Optional roller centralisers are available where telescoped casing strings are present





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Optical Formation Imager

(OFI)

Georesources

- Coal mine exploration and production
- Coal seam gas
- Conventional Oil and Gas
- Unconventional Oil and Gas
- Base metals
- Industrial and metallic minerals
- Hydrogeology
- Geotechnics
- Mine paste holes

Mechanical specifications



Clteq

Outside Diameter (OD)	52 mm	1.7 in	
Length	163 cm	64.0 in	
Weight in Air	5 kg	11 lb	
Pressure Rating	20.0 MPa	2,900 psi	
Temperature Rating	80 °C	176 °F	
Min. Casing Diameter	70 mm	2.8 in	
Max. Casing Diameter	508 mm 20.0 in		
Logging Speed	2 – 9 m/min 6.5 – 30 ft/min		
Borehole Fluid	Fresh and Saline Wate	Fresh and Saline Water, Air, Water Based Mud (WBM)	
Sample Interval	Unlimited, deter	Unlimited, determined by logging speed	
Azimuth Resolution	User selectable (360, 72	User selectable (360, 720, 900, 1,080, 1,260, 1,440 pixels)	
Sensor	1,280 x 1,024 CMOS, 24 bit RGB (true colour)		
Senor Optics	360 deg° circle vi	360 deg° circle view lens, focus 0 to infinity	
Sensor Shutter	Logarithmic rolle	Logarithmic roller shutter – user adjustable	

Measurement specifications

	Gamma Ray	0 – 10,000 API	
	Colour Depth	24 bit RGB	
Range		16,777,216 discrete colours	
	Deviation	0 – 360° azimuth	
	Deviation	0 – 180° borehole tilt	
	Gamma Ray	+/- 5% of measured value	
Accuracy	Deviation	+/- 0.5° azimuth	
		+/- 0.2° borehole tilt	
	User selectable (Magnet	tic North, True North, High Side)	
Image evientation	Magnetic North – Open Hole		
Image orientation	True North – Open Hole (default)		
	High Side – Magnetic interference (oriented with gyro)		
	GROF in GAPI	Gamma Ray	
	OMAP (pixel, RGB)	True Colour Map Array	
	TILT, AZIT in DEG°	Borehole Title and Azimuth	
Sonde Curves	FMAG in nT	Magnetic Field Magnitude	
and Mnemonics	AMAG in g	Acceleration Magnitude	
	RBHS in deg [°]	Relative Bearing High Side	
	XMAG, YMAG, ZMAG	G 3 Axis Magnetometer	
	XACC, YACC, ZACC	3 Axis Accelerometer	

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Four Arm Dipmeter Sonde

C,teq

(FADS)

The Four Arm Dipmeter Sonde (FADS), provides dip azimuth and magnitude for structural and depositional applications. The FADS comprises a four caliper arm mechanism, coupled to a precision 3 axis magnetometer and accelerometer package for orientation.

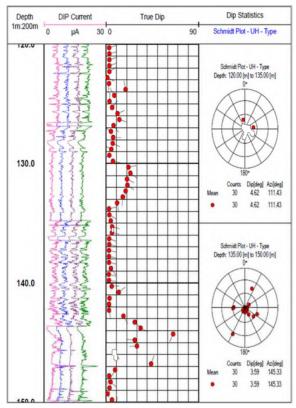
The four caliper arms are configured in a two axis arrangement (X and Y), where each axis is orthogonal to one another, and perpendicular to the sonde long axis.

Each caliper arm incorporates a dip meter pad that contains one insulated button electrode. Each pad injects current into the formation, and current density is measured by the button electrode. This results in four microresistivity values per depth interval.

Planar features such as bedding and fractures are identified when resistivity contrasts exist, either between adjacent planes, or between planes and the formation. Where planar features are not perpendicular to the borehole, resistivities will be depth displaced as each pad will record the resistivity change at a different depth.

Planar features are identified by cross correlation analysis, where four microresistivity curves are correlated to determine the best fit and matching between curves.

This provides 4, three-point measurement solutions to the feature plane, where apparent dip azimuth and magnitude can be calculated trigonometrically.



Apparent measurements which are referenced to a plane that is perpendicular to the borehole axis, and whose azimuth rarely coincides with the azimuth of the feature plane, are converted to true measurements using the sonde orientation.

Applications

- Structural dip azimuth and dip magnitude
- Structural interpretation
- Sedimentary features Identifying depositional mechanism
- Thin bed evaluation
- Identifying zones of break out and determining SHmax and Shmin directions
- Borehole geometry
- Borehole deviation analysis

Features

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- Real time dip processing field deliverable without the need for post processing
- User selectable correlation interval, step distance and search angle adjusts the correlation, depending on the application
- Four caliper arms provide redundancy, as only three points are necessary to define a feature plane
- Precision 3 axis magnetometer and accelerometer package referenced to the caliper arms for orientation
- High sidewall force maintains dipmeter pad contact
- Inline swivel to reduce sonde rotation
- Non-magnetic basket centraliser maintains tool centralisation through all borehole sizes
- Gamma ray measurement for depth correlation

Qteq

(FADS)

Georesources

- Coal mine exploration and production
- Coal seam gas
- Conventional Oil and Gas
- Unconventional Oil and Gas
- Base metals
- Industrial and metallic minerals
- Geotechnics

Mechanical specifications

Outside Diameter (OD)	57 mm	2.3 in	
Length	323 cm	127 in	
Weight in Air	35 kg	76 lb	
Pressure Rating	34.5 MPa	5,000 psi	
Temperature Rating	85 ℃	185 °F	
Min. Borehole Diameter	96 mm	3.8 in	
Max. Borehole Diameter	305 mm	12.0 in	
Logging Speed	6 m/min	20 ft/min	
Borehole Fluid	Water Ba	Water Based Mud (WBM)	
Sample Interval	5 r	5 mm (0.2 in)	
Gamma Detector	22 x 89 mm Nal scintillation crystal		
Number of Pads	4		
Measuring Electrodes	4 (1 button per pad) @ 6 mm diameter		
Dip Processing	Automatic cross correlation		

Measurement specifications

	Gamma Ray	0 – 10,000 API
Danas	Caliper	0 – 305 mm (0 – 12.0 in)
Range	Micro Resistivity (A)	0 - 10,000 µA
	Deviation	0 – 360°, 0 – 50° (tilt)
	Gamma Ray	+/- 5% of measured value
	Caliper	+/- 2.54 mm (0.10 in)
Accuracy	Micro Resistivity (A)	+/- 0.5° of measure value
	Deviation	+/- 0.5° azimuth
	Deviation	+/- 0.2° borehole tilt
	GRFD in GAPI	Gamma Ray
	CALX in mm	Caliper X Axis
	CALY in mm	Caliper Y Axis
	TILT, AZIT in deg°	Borehole Tilt and Azimuth
	CUR1 in µA	Pad 1 Current
Sonde Curves	CUR2 in µA	Pad 2 Current
and Mnemonics	CUR3 in µA	Pad 3 Current
	CUR4 in µA	Pad 4 Current
	P1AZ in deg°	Pad 1 Azimuth
	DIPM in deg [°]	Processed Dip Magnitude
	DIPA in deg ^e	Processed Dip Azimuth
	Various in m, DEG°	Deviation Analysis



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Wellbore Orientation Tool



(WOT)

The Wellbore Orientation Tool (WOT) provides the necessary positioning information for Dipmeter processing.

The WOT can be run alone or in combination with other open hole tools to obtain a deviation or drift survey in real time.

Hole deviations to 90 degrees are measured with a high resolution, solid state, 3 axis inclinometer package with +/- 2% accuracy.

Azimuth and relative bearing are measured with a 3 axis flux gate magnetometer to within +/- 3%.

Applications

- Open hole
- Fluid or air filled holes
- Fresh or salt muds

Specifications

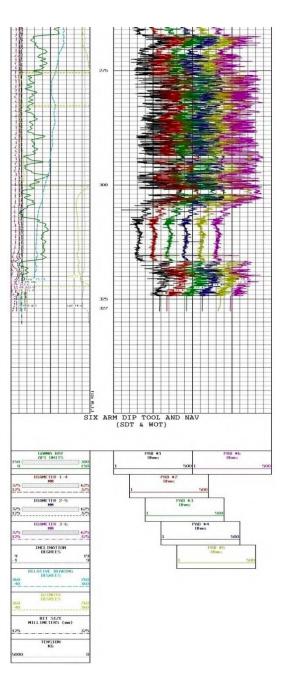
Pressure	20,000 psi	1,379 bar
Temperature	325 °F	163 °C
Tool length	5.7 ft	1.7 m
Tool O.D.	3.4 in	86 mm
Min. Borehole size	4.75 in	120 mm
Max. Borehole size	22.0 in	560 mm

Measurement range

Inclination	0 – 90 deg	
Azimuth	0 – 360 deg	
Relative bearing	0 – 360 deg	

Vertical resolution

		0.12 in	31 mm	
Max. Lo	gging Speed	30 ft/min	9 m/min	



Typical presentation

Technical Specification Sheet

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Formation Evaluation Tool

Cteq

(FET)

The Formation Evaluation Tool (FET) is a pump through fluid sampling tool capable of capturing up to 9 multi samples and 4 x 524 cc PVT samples in a single trip in the well.

The array of fluid sensors combined with the versatile surface software ensures the samples acquired down hole are clean and viable.

Pump rates and drawdown volume can be adjusted real time to ensure an accurate shut in pressure (SIP). In addition, the FET can pump from the borehole into the formation (reverse pump).

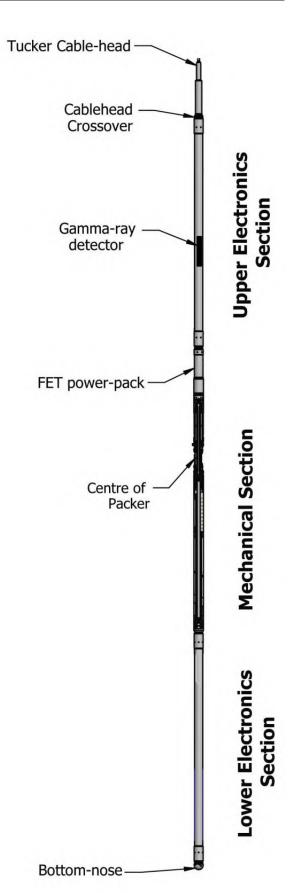
The benefit of reverse pumping is the tool's ability to "pump off" the formation, an advantage if the tool has been set for long periods during testing.

Applications

Fluid filled holes

Specifications

Pressure	15,000 psi	1,034 bar
Temperature	302 °F	150 °C
Tool length (basic tool)	38.7 ft	11.8 m
Tool length w/ PVT	42.97 ft	13.1 m
Tool O.D.	5.5 in	140 mm
Min. Borehole size	6.5 in	165 mm
Max. Borehole size	17.5 in	444.5 mm
Pump parameters		
Pump stroke	0.26 gal	1 L
Max. Flow rate	1.1 gal	4 L/min
Sample capabilities		
Multi-sampler	9 x 0.01 gal	9 x 50 cc
PVT sample	2 x 0.25 gal	2 x 524 cc
Sensor specifications		
Resistivity	0.1 – 10 oh	imm
Conductivity	0 – 20 ohm	m/m
Temperature	0 – 200 °	°C
Density	0 – 2 g/d	c



Technical Specification Sheet

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Formation Evaluation Tool

(FET)

Pressure gauges

Quartz pressure gauge			
Range	0 – 16,000 psi	0 – 1,103 bar	
Sensitivity	0.01 psi		
Accuracy	0.01% full scale		

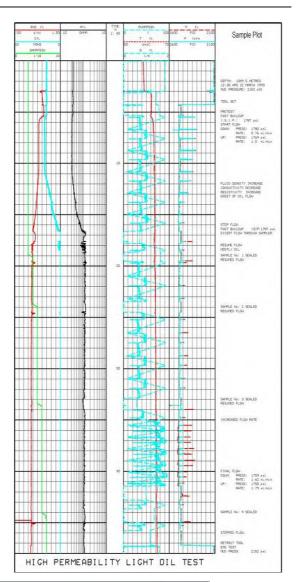
Pressure gauges Strain gauge

Range Sensitivity

0.02% full scale

0 – 1,103 bar

0 – 16,000 psi



FET Software - Main Window - - X S2 S3 S4 S5 S7A S7B S8 DUMP Head Voltage: 18.48 Flow Rate: 0.00 L/min nd Count: 4 Frame Count: 4005 Raw Depth: 0.00 M Accumulated Volume Mete 0.001 Command Errors: 0 All ON (Blue) All OFF (Yellow) Cable Depth: 0.00 M Frame Errors: 0 Start Stop Reset and Failures: 0 Packer ⊻ 5.54 M hrase Counters: 📀 Temp: O Deg C O Deg F View Log Data: 😡 th: 🔾 M 🛛 🖯 FT t Counters Node Query Eq.Piston 1: PC1 Motor RPM: 0 Pressure: 🔘 kPa 🔘 PSIA 🔵 Flow Rate: O L/min O gal/min Eq.Piston 2: Weight: 🔘 kg 🛛 Ibs Density: O g/cc O lb/gal Motor Temp: 10 UC Temp: 82.35 °C OFF Log Up Log Down Log Time Stop Log Packer Volume: O L O cc O gal Set Pressure: -5 PSI LC Temp: 94.57 °C etup Calibration Tool Control GR Set/Retract DIP Inflation DIP Sampling Pretest Displacement Multisample PVT Sample D ables Plot T DIP Inflation Help G DIP Monitoring Top: Deflated DIP Inflation Differential Pressure Monitoring Inflation port sou Packer Upper Inflation to Upper Port: 67.9 PSI Upper Inflation to Middle Port: 41.6 PSI Set Cancel ower Inflation to Middle Port: 69.8 PSI Top Packer... 94.1 PSI Pumped Volume Monit . Start Inflat Upper DIP Volume: 0.00 L @ Reset 3. Pause Inflat Lower DIP Volume: 0.00 L 💁 Reset 42.75 °C 19.7376 ohm 10074.811 M 7. Release EDV esired Diff Inflation Pressure: 400 🚔 PSI Bottom Packer. Flowline 341.8 PSIA 53.34 °C

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Technical Specification Sheet

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Borehole Geometry Sonde

(BGS)

The Borehole Geometry Sonde (BGS), comprises an independent 4 arm caliper mechanism, coupled to a precision 3 axis magnetometer and accelerometer package. The sonde provides orientated borehole geometry for both open hole and cased hole applications.

The four caliper arms are configured in a two axis arrangement (X and Y), where each axis is orthogonal to one another, and perpendicular to the sonde long axis.

Each caliper arm is individually spring loaded, whereby a compression spring provides sufficient sidewall force to maintain contact with the borehole wall. The compression spring also absorbs caliper arm movement as a result of changes in borehole diameter through sections of enlargements, restrictions, washouts, breakout and rugosity.

Caliper arms are motorised open and closed by a DC gear motor. A push rod mechanism drives a linear potentiometer that varies its output dependant on caliper arm movement.

Applications

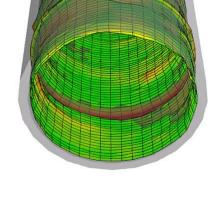
- Identifying zones of break out and determining SHmax and Shmin directions
- Caliper corrections for geophysical wireline data
- · Identifying borehole elongation, rugosity and washouts
- Assessing efficacy of under-reaming operations
- Borehole geometry of induced cavities used for in situ leaching size, orientation and depth
- High resolution annular and hole volumes
- Blast hole shot optimisation
- Casing and tubular integrity investigation, quantifying wear, damage, corrosion and restrictions to casing, tubing, screens and production strings
- Identifying filter cake, and permeable formations
- Assessing formation geometry for packer setting

Features

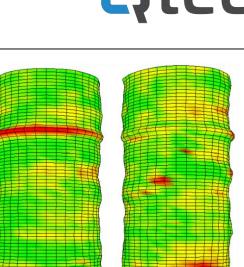
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- 4 independent radius measurements
- Fast logging speeds of up to 12 m/min
- Precision 3 axis magnetometer and accelerometer package referenced to • the caliper arms for orientation
- Multiple logging passes can be merged together, providing an ever higher resolution caliper map
- Inline swivel to reduce sonde rotation •
- Non-magnetic basket centralisers maintain tool centralisation, minimising caliper setting across the chord
- Gamma ray and CCL measurements for depth correlation
- More accurate annular and hole volumes, than compared with single, dual and three arm calipers



Technical Specification Sheet



Jteq

(BGS)

Georesources

- Coal mine exploration and production
- Coal seam gas
- Conventional Oil and Gas
- Unconventional Oil and Gas
- Base metals
- Industrial and metallic minerals
- Hydrogeology
- In situ leach (borehole mining)

Mechanical specifications

Outside Diameter (OD)	38 / 70 mm	1.5 / 2.8 in
Length	178 cm	83.0 in
Weight in Air	22 kg	48 lb
Pressure Rating	20.0 MPa	2,900 psi
Temperature Rating	80 °C	176 °F
Min. Borehole Diameter	75 mm	3.0 in
Max. Borehole Diameter	1,016 mm	40.0 in
Logging Speed	12 m/min (720 m/hr)	40 ft/min (2,360 ft/hr)
Borehole Fluid	Air, Water Based Mud (W	/BM), Oil Based Mud (OBM)
Sample Interval	User selectable (0.5, 1, 2, 10, 20 cm)	
Caliper Arrangement	4 caliper arms at 90° spacing – X and Y axis	
Casing Collar Locator	Optional	
Gamma Detector	25 x 50 mm Nal	scintillation crystal
Caliper Measurement	Linear potentiometer	

Measurement specifications

	Gamma Ray	0 – 10,000 API
	Caliper	0 – 1,016 mm (0 – 40.0 in)
Range	Casing Collar Locator	-10,000 mV – 10,000 mV
		0 – 360° azimuth
	Deviation	0 – 90° borehole tilt
	Gamma Ray	+/- 5% of measured value
	Calliper	+/- 2.54 mm (0.10 in)
Accuracy		+/- 0.5° azimuth
	Deviation	+/- 0.1° borehole tilt
	GRBF in GAPI	Gamma Ray
	CALX in mm	Caliper X Axis
	CALY in mm	Caliper Y Axis
	RAXA in mm	Radius X Axis 1
	RAXB in mm	Radius X Axis 2
Sonde Curves and Mnemonics	RAYA in mm	Radius Y Axis 1
and Minemonics – – – –	RAYB in mm	Radius Y Axis 2
	CCL in CPS or mV	Casing Collar Locator
	HVOL / AVOL in m ³	Hole / Annular Volume
	TILT / AZIT in DEG°	Borehole Tilt / Azimuth
	Various in m, DEG°	Deviation Analysis

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Technical Specification Sheet

Llteq

Resistivity Imaging Tool (RIT)

The RIT Resistivity Imaging Tool is designed to obtain high quality image with high operational efficiency. The tool extends the range of operation from highly resistive formations and highly conductive boreholes.

The used of DSP (Digital signal processing) in processing button data eliminates noise and offset errors. Digitizing button data in the pad eliminated cross-talk induced errors in the mandrel section. This allows the sampling of two buttons simultaneously, thus increasing the sampling time of each button. Digital signal processing is performed on the button data waveforms which reduced errors

Applications

- Structural analysis
- Detailed stratigraphic and sedimentological analysis
- Dip and strike determination
- Fracture identification and characterization

Features and Benefits

- Provides high-resolution images
- Combinable with acoustic and ultrasonic imaging services



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Resistivity Imaging Tool (RIT)

Specifications

Maximum Temperature Maximum Pressure

Make-up Length Weight Tool Diameter Minimum Hole Diameter Maximum Hole Diameter Arms Pad Force (approx) Calipers Hole Deviation Tool Positioning Borehole Fluids Sampling Rate Logging Speed

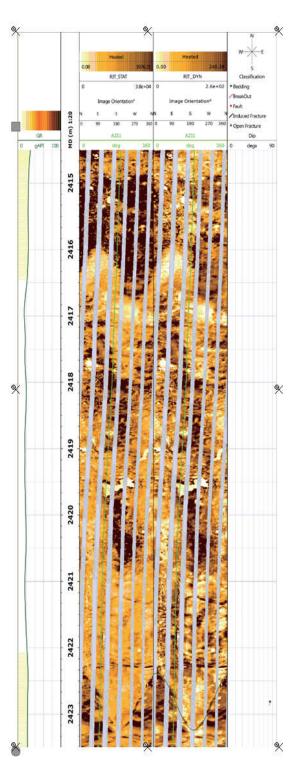
Logging Speed Hardware Characteristics Sensor Type Sensor No. Sensor Spacings

Measurement Range Borehole Coverage Caliper Range Diameter Combinations Max Tensile Force

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6 hours at 400°F (200°C) 20000 psi (137.88 MPa) (1406.0 kg/cm²) Tool 25.24 ft (7.69 m) 496 lb (97.5 kg) 5 in. (127 mm) 5.875 in. (149 mm) 21.0 in. (533.4 mm) 6 independent 5-55 lbf (2.3-24.9 kgf) (Adjustable) 6 independent readings Vertical to Horizontal Centralized Salt/Fresh 120 samples/ft 4.6 m/min (15 ft/min)

Micro-Resistivity Buttons 150 Buttons - 25 Buttons per Pad 2 rows containing 12&13 sensors, respectively 0.300 in. between rows 0.200 in. between sensors on each row 0.100 in. between sensors when both rows are superimposed 0.2-10,000 ohm-m 0<Rt/Rm<20,000 67% in 8 in. diameter borehole 5.0 in. to 21 in. (127-533 mm) Pad Ultrasonic Scan Imaging Tool (USI) 130,000 lbf Max Compressive Force



LJteq

The USI tool is an acoustic device designed to produce detailed images of the wellbore wall (or casing). The USI pulse-echo transducer emits a high frequency acoustic pulse and measures the amplitude and the time of flight of the reflected wave. The amplitude of the reflected wave is affected by variations in the borehole surface. The travel time is indicative of the distance from the transducer to the wellbore wall. The acoustic transducer is mounted on a rotating section, allowing the USI to scan the full 360 degrees of the wellbore producing two images or map

Applications

- Structural and bedding analysis Completing detailed fracture studies Dip and strike determination
- Determining high-resolution borehole shape
- Stress analysis and borehole stability studies

Features and Benefits

- Measures acoustic amplitude reflectance and two-way travel-time
- Full 360° coverage of the borehole with images containing up to 256 data samples
- Reliably operates in any mud type

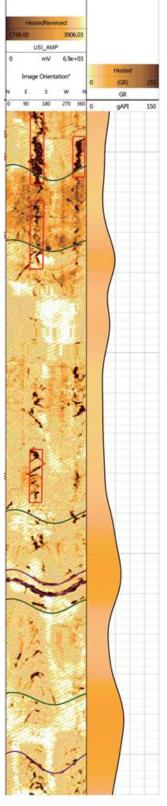
Technical Specification Sheet

LJteq

Ultrasonic Scan Imaging Tool (USI)

Specifications

Maximum Temperature 6 hours	at 400°E (200°C)
Maximum Pressure	20000 psi (137.88 MPa) (1406.0 kg/cm ²) Tool
Diameter	
Electronics	3.375 in. (8.57 cm)
Mandrel	3.625 in. (9.21 cm)
Make-up Length	
Electronics	7 ft5.8 in. (2.26 m)
Mandrel	8 ft0.6 in. (2.45 m)
Shipping Length	
Electronics	8 ft11.8 in. (2.74 m)
Mandrel	9 ft1.3 in. (2.78 m)
Tool Weight	
Electronics	120 lb (54.4 kg)
Mandrel	150 lb (68.0 kg)
Shipping Weight	
Electronics	140 lb (63.5 kg)
Mandrel	170 lb (77.1 kg)
Maximum Tensile Force	
Electronics	40,000 lbf
Mandrel	17,500 lbf
Maximum Compressive Force	
Electronics Mandrel	4,000 lbf
Transmission Digital	4,000 lbf
Wireline Requirements	7 conductor
Samples per Scan	250/125
Scan Speed	11 scans per second, nominal Imaging Transducer
Imaging Transducers Quantity	2
	1.5 in. (38.1 mm), and 2.0 in. (50.8 mm) focused,
Size/type	1.5 III. (50.1 IIIIII), and 2.0 III. (50.6 IIIII) focused,
ceramic	
Frequency of Operation	250 kHz
Orientation Facility	Internal Magnetometer, or reference
Fluid Velocity Reference	Internal self-contained 250 kHz transducer
Logging Speed,	
Vertical Resolution	10 ft./min.(3.05 m/min), 60 scans per foot (s.p.f.) 20
(6.10 m/min) @ 30 s.p.f.	
Radial Resolution Typically	10 samples per inch in an 8 inch borehole



0 ft./min.

Technical Specification Sheet

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Ultrasonic Scan Imaging Tool (USI)

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WIRELINE SERVICES

TECHNICAL SPECIFICATION SHEETS CASED HOLE SERVICES

Ultrasonic Casing Imager



(UCI)

The Ultrasonic Casing Investigation (UCI), comprises a focused ultrasonic transducer and rotating reflector lens, coupled to a precision 3 axis magnetometer and accelerometer package to provide orientation.

The reflector lens is rotated up to 20 revolutions per second by a very accurate stepper motor and position resolver. During each rotation, the reflector stops a definable number of times (90, 180, 270 or 360), and the transducer outputs a constant power ultrasonic wavetrain. The transducer then receives the reflected wavetrain from the inside casing surface. Both the transit time and reflection energy (amplitude) are recorded.

An internal defect map derived from the amplitude is used to evaluation corrosion, wear, damage and other defects by changes to this amplitude.

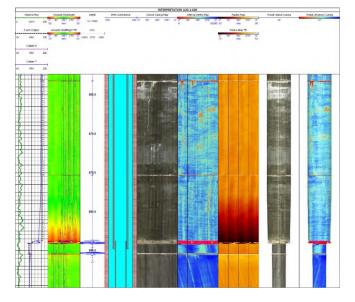
A fluid transform converts the transit time map to a high resolution radius map with up to 360 acoustic caliper measurements. The radius map is applied to the defect map and OCI image map to produce true 3D casing projections. An ultrasonic multifinger caliper is output to aid in interpretation.

Percentage metal loss is calculated by comparing the original casing dimensions with the measured internal diameter from the high resolution radius map. This provides for true quantitative evaluation.

The UCI works in all drilling fluids, and with all fluid additives. The UCI does not require clear well fluids like the OCI.

Applications

- Casing and tubular integrity investigations quantifying wear, damage, corrosion and restrictions to casing, tubing and production strings
- Joint analysis
- Casing thickness and percentage metal loss
- Identification and elucidation of unknown wellbore completions
 - Verification of cased hole operations such as:
 - o Perforation placement
 - o Wellbore relining and refurbishment
 - o Fishing and slickline operations
- Assessment of screens for integrity and blockages
- Wellbore deviation analysis in non-magnetic casings

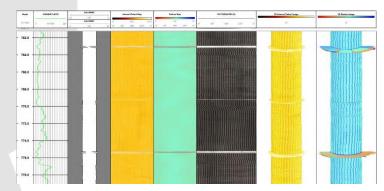


Features

- Focussed 1.5 MHz piezoelectric transducer
- Fast logging speeds of up to 6 m/min
- Able to resolve features down to 1.0 mm
- Continuous circumferential defect and radius maps over the entire wellbore
- Wideband transducer allows measurements in 60 508 mm boreholes
- Precision 3 axis magnetometer and accelerometer package referenced to the transducer for orientation
- Non-magnetic basket centralisers maintain tool centralisation through all wellbore sizes
- Optional roller centralisers are available where telescoped casing strings are present

Georesources

- Casing integrity investigations
- Mine paste holes
- Coal seam gas
- Conventional Oil and Gas
- Unconventional Oil and Gas
- Hydrogeology



Technical Specification Sheet

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Qteq

(UCI)

Mechanical specifications

Outside Diameter (OD)	42 mm	1.7 in
Length	207 cm	81.0 in
Weight in Air	10 kg	22 lb
Pressure Rating	20.0 MPa	2,900 psi
Temperature Rating	70 °C	158 °F
Min. Borehole Diameter	60 mm	2.4 in
Max. Borehole Diameter	508 mm	20.0 in
Logging Speed	4 – 7 m/min	7 - 23 ft/min
Borehole Fluid	Fresh and Saline Water, Water Based Mud (WBM), Oil Based Mud (OBM)	
Sample Interval	Unlimited, determined by logging speed	
Azimuthal Resolution	User selectable (90, 180, 270, 360 shots per revolution)	
Transducer	Piezoelectric, Composite Focussed 1.0 in	
Transducer Frequency	1.5 MHz	

Measurement specifications

	Gamma Ray	0 – 10,000 API	
Dance	Caliper	60 – 508 mm (0 – 20 in)	
Range	Deviation	0 – 360° azimuth	
	Deviation	0 – 180° borehole tilt	
	Gamma Ray	+/- 5% of measured value	
	Caliper	+/- 0.05 mm (0.002 in)	
Accuracy	Transit Time	+/- 0.1 µsec	
Accuracy	Amplitude	+/- 1.0 amplitude units	
	Deviation	+/- 0.5° azimuth	
	Deviation	+/- 0.2° borehole tilt	
	User selectable (Magnet	ic North, True North, High Side)	
Image Orientation	Magnetic North – Open Hole		
image offentation	True North –	True North – Open Hole (default)	
	High Side – Magnetic Interference (oriented with gyro)		
	GRAF in GAPI	Gamma Ray	
	AMAP (deg°, mV)	Amplitude Map Array	
	TMAP (deg°, μs)	Transit Time Map Array	
	RMAP (deg°. mm)	Radius Map Array	
Sanda Cumun	AFMC (deg°, mm)	Acoustic Multifinger	
Sonde Curves and Mnemonics	TILT, AZIT in DEG°	Borehole Tilt Azimuth	
and whemomes	FMAG in nT	Magnetic Field Magnitude	
	AMAG in g	Acceleration Magnitude	
	RBHS in deg°	Relative Bearing High Side	
	XMAG, YMAG, ZMAG	3 Axis Magnetometer	
	XACC, YACC, ZACC	3 Axis Accelerometer	



Optical Casing Imager

C)teq

(OCI)

The Optical Casing Investigation (OCI), comprises a very high resolution CMOS image sensor, coupled to a precision ground glass circle view lens. This provides a continuous optical assessment of the wellbore casing, able to resolve features down to 0.5 mm.

The 360 deg° circle view lens provides a focussed horizontal image disc perpendicular to the sonde axis, approximately 0.5 mm in height. Each "image disc" is stacked to provide a continuous circumferential panorama of the wellbore.

The image sensor is aligned with a precision 3 axis magnetometer and accelerometer package to provide an orientated image in PVC, glass reinforced epoxy (GRP), or fibre reinforced polymer (FRP) casings. Gyroscopic deviation can be used for orientation in steel casings.

The OFI does not look downhole like conventional CCTV devices, but looks "sideways", offering unparalleled wellbore coverage, resolution and interpretation potential over any other optical of camera system available.



Applications

- Casing and tubular integrity investigations identifying wear, damage, corrosion and restrictions to casing, tubing and production strings
- Joint analysis
- Identification and elucidation of unknown wellbore completions
 - Verification of cased hole operations such as:
 - o Perforation placement
 - o Wellbore relining and refurbishment
 - o Fishing and slickline operations
- Assessment of screens for integrity and blockages
- Wellbore deviation analysis in non-magnetic casings

Features

- Very high resolution 1,280 x 1,024 pixel CMOS image sensor and 360 deg° circle view lens
- Continuous circumferential 3D panorama
- Fast logging speeds of up to 9 m/min
- Both sensor and les are fixed, with no requirement for rotation by a motor assembly
- Precision 3 axis magnetometer and accelerometer package referenced to the image sensor for orientation
- High efficiency white LEDs provide excellent illumination, even in turbid fluids
- Light output controlled real time by 20 user selectable settings
 in software
- Non-magnetic basket centralisers maintain tool centralisation
 through all wellbore sizes
- Optional roller centralisers are available where telescoped casing strings are present



Technical Specification Sheet

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Optical Casing Imager

(OCI)

Georesources

- Casing integrity investigations
- Mine paste holes
- Coal seam gas
- Conventional Oil and Gas
- Unconventional Oil and Gas
- Hydrogeology

Mechanical specifications

Outside Diameter (OD)	52 mm	1.7 in
Length	163 cm	64.0 in
Weight in Air	5 kg	11 lb
Pressure Rating	20.0 MPa	2,900 psi
Temperature Rating	80 °C	176 °F
Min. Borehole Diameter	70 mm	2.8 in
Max. Borehole Diameter	508 mm	20.0 in
Logging Speed	2 – 9 m/min	6.5- 30 ft/min
Borehole Fluid	Fresh and Saline Water, Air, Water Based Mud (WBM)	
Sample Interval	Unlimited, determined by logging speed	
Azimuthal Resolution	User selectable (360, 720, 900, 1,080, 1,260, 1,440 pixels)	
Sensor	1,280 x 1,024 CMOS, 24 bit RGB (true colour)	
Sensor Optics	360 deg° circle view lens, focus 0 to infinity	
Sensor Shutter	Logarithmic rolling shutter – user adjustable	

Measurement specifications

	Gamma Ray	0 – 10,000 API	
	Gamma Ray	24 bit RGB	
Range	Colour Depth	16,777,216 discrete colours	
hange		$0 - 360^\circ$ azimuth	
	Deviation	0 – 180° borehole tilt	
	Gamma Ray	+/- 5% of measured value	
Accuracy		+/- 0.5° azimuth	
	Deviation	0 – 180° borehole tilt	
	User selectable (Mag	netic North, True North, High Side)	
	Magnet	Magnetic North – Open Hole	
Image Orientation	True Nort	True North – Open Hole (default)	
	High Slide – Magneti	High Slide – Magnetic Interference (oriented with gyro)	
	GRAF in GAPI	Gamma Ray	
	OMAP (pixel, RGB)	True Colour Map Array	
	TILT, AZIT in DEG°	Borehole Tilt and Azimuth	
Sonde Curves	FMAG in nT	Magnetic Field Magnitude	
and Mnemonics	AMAG in g	Acceleration Magnitude	
	RBHS in deg [°]	Relative Bearing High Side	
	XMAG, YMAG, ZMAG	3 Axis Magnetometer	
	XACC, YACC, ZACC	3 Axis Magnetometer	

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Technical Specification Sheet

Qteq

Downhole Camera

Qteq

(CAM)

The Qteq Downhole Camera service provides a high resolution colour image of both a downhole and a 360 deg side view of the borehole in a single pass.

Standard resolution data is transmitted in real time and a high resolution image is recorded into memory. If an item of interest is identified, a high resolution image can be transmitted to surface for immediate analysis.

Preview real time image data can be viewed over a Wi-Fi link on any device such as tablets, computers of smartphones

When the camera is returned to surface, the recorded high resolution data can be transferred via a physical or Wi-Fi link for detailed analysis.

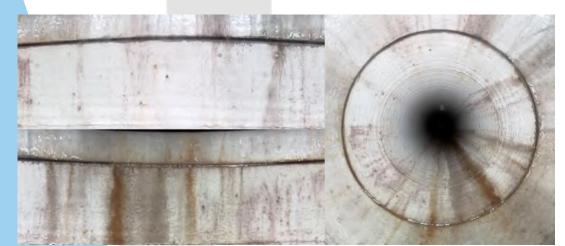
Applications

•

- Casing and tubular integrity investigations identifying wear, damage, corrosion and restrictions to casing, tubing and production strings
- Imaging dropped objects and wellbore fish
- Identification and understanding of unknown wellbore completions
- Verification of cased hole operations such as:
- o Perforation placement and inspection
- o Wellbore relining and refurbishment
- o Fishing and slickline operations
- Assessment of screens for integrity and blockages
- Mechanical inspection of wellbore hardware
- Detecting water entry in gas wells and oil entry in high water cut wells
- Open hole imaging of barefoot completions
- Sand entry detection
- Inspection of large diameter shafts with optional high intensity lighting package

Features

- Simultaneous down and side views
- Adjustable intensity lighting
- Option of high intensity lighting package for large diameter bores
- Viewing of data over wi-fi connection
- Small 43mm diameter
- Short length of 323mm



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Downhole Camera

(CAM)

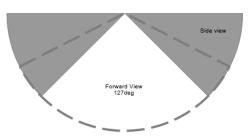
Georesources

- Casing integrity investigations
- Mine paste holes
- Coal seam gas
- Conventional Oil and Gas
- Unconventional Oil and Gas
- Hydrogeology
- Ventilation shafts
- Mine shafts

Mechanical specifications

Outside Diameter (OD)	43 mm	1.7 in	
Length	323 mm	12.7 in	
Weight in Air	4.2 kg	9.25 lb	
Pressure Rating	20.0 MPa	2,900 psi	
Temperature Rating	70 °C	158 °F	
Min. Borehole Diameter	70 mm	2.8 in	
Max. Borehole Diameter	10m	400 in	
Logging Speed	1.5 to 2 m/min	5- 6.6 ft/min	
Borehole Fluid	Fresh and Saline Water, Air, Water Based Mud (WBM)		
View angle	180 / 360 Degrees		
Frame Rate		10 to 15 fps	
Resolution		1280 x 960	
Video Format	MPEG4 (.mp.4)		
Bit rate		2 Mb/s	
Encoding		.H2264	
Streams Recorded	Side stream, Front stream		





360 View

Technical Specification Sheet

qteq.com.au info@qteq.com.au Side vie

C, teq

Cement Bond Log

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(CBL)

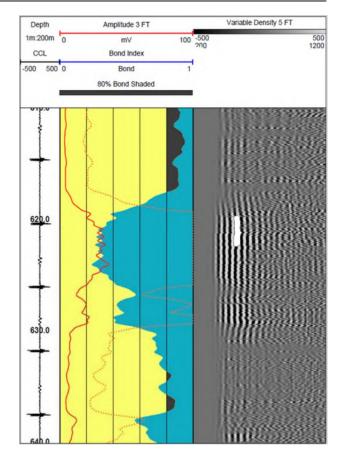
The Cement Bond Log (CBL), provides quantitative and qualitative evaluation of the cement bond quality and integrity, to both casing and formation. This evaluation is crucial in ensuring the objectives of the primary cement job have been achieved:

- Zonal isolation of aquifers, production and lost circulation zones
- Maintenance of well control
- Support of subsequent tubing strings
- Minimising error in cased hole logging measurements

The CBL comprises a piezoelectric transmitter and two omni directional receivers, separated by an acoustic isolator to disengage direct transmission along the sonde body. The receiver spacing is a standard 3 - 5 ft arrangement.

Contrasts of acoustic impedance between steel, fluid, cement and formation, as well as the annular composition, determines how the acoustic wavetrain is attenuated, and the resultant amplitude of the first arrival. Analysis of the near receiver amplitude via a fixed or sliding gate algorithm is used to determine the casing to cement bond. High amplitude values indicate poor cement to casing bond, while low values indicate good bond.

The amplitude is used to create a bond index which indicates the circumferential percentage of casing bond or no bond. The variable density log (VDL), is used to qualitatively assess the cement bond quality and integrity to both casing and formation.



Applications

- Cement bond quality and integrity to both casing and formation
- Efficacy of zonal isolation
- Location of free pipe
- Top of cement
- Identification of micro-annulus
- Assessing if cement remediation is required
- Post remediation evaluation

Features

- 24 kHz piezoelectric transmitter
- Piezoelectric near and far omni receivers
- Selectable sample intervals of 1, 2, 5, or 10 cm
- 4 msec RX recording window
- VDL, amplitude and transit time for quantitative and qualitative evaluation of the cement bond quality
- Fixed or sliding gate picking of E³ arrival
- Short sonde length
- Slim OD package
- Gamma ray and CCL measurements for depth correlation
- Basket centralisers maintain tool centralisation through all casing sizes

Technical Specification Sheet

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Cement Bond Log

(CBL)

Georesources

- Coal mine exploration and production
- Coal seam gas
- Conventional Oil and Gas
- Unconventional Oil and Gas
- Hydrogeology

Mechanical specifications

Outside Diameter (OD)	51 mm	2.0 in
Length	354 cm	139.0 in
Weight in Air	22 kg	50 lb
Pressure Rating	17.2 MPa	2,500 psi
Temperature Rating	85 °C	185 °F
Min. Casing Diameter	76 mm	3.0 in
Max. Casing Diameter	264 mm	10.8 in
Logging Speed	4.5 – 9 m/min	15 – 30 ft/min
Borehole Fluid	Brine, Water Based Mud (WBM), Oil Based Mud (OBM)	
Sample Interval	User selectable (1, 2, 10, 20 cm)	
Gamma Detector	22 x 102 mm Nal scintillation crystal	
Transmitter	Monopole Piezoelectric @ 24 kHz	
Receivers Omni	Piezoelectric, 2 – 4 TX @ 30, 60, 90, 120 cm spacings	
First Arrival Detection	Threshold Zero Crossing	

Measurement specifications

	Gamma Ray	0 – 10,000 API
Denne	Receiver Time Domain	0 – 4,096 µsec
Range	Receiver Amplitude	-2,500 mV – 2,500 mV
	Casing Collar Locator	-10,000 mV – 10,000 mV
	Gamma Ray	+/- 5% of measured value
Accuracy	Receiver Time Domain	+/- 0.5 µsec
	Receiver Amplitude	+/- 2% of measured value
	GRDT in GAPI	Gamma Ray
	TRNR in µsec	Near Transit Time
	TRFR in µsec	Far Transit Time
	AMPN in mV	Normalised Near Amplitude
Sonde Curves	AMPF in mV	Normalised Far Amplitude
and Mnemonics	AMPR in mV	Free Pipe Amplitude Ref
	BOND in %	Bond Index
	CCL in CPS or mV	Casing Collar Locator
	VDL3 array (µsec, mV)	Near Variable Density Log
	VDL3 array (µsec, mV)	Far Variable Density Log

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Technical Specification Sheet

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Radial Bond Log

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(RBL)

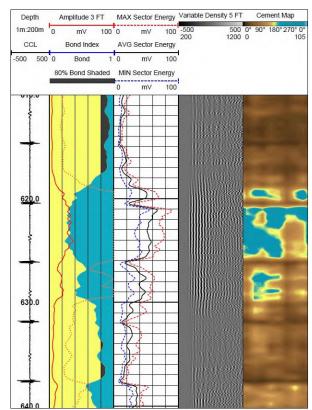
The Radial Bond Log (RBL), provides quantitative and qualitative evaluation of the cement bond quality and integrity, to both casing and formation. This evaluation is crucial in ensuring the objectives of the primary cement job have been achieved:

- Zonal isolation of aquifers, production and lost circulation zones
- Maintenance of well control
- Support of subsequent tubing strings
- Minimising error in cased hole logging measurements

The RBL comprises a piezoelectric transmitter and two omni directional receivers, separated by an acoustic isolator to disengage direct transmission along the sonde body. The receiver spacings is a standard 3-5 ft arrangement.

Contrasts of acoustic impedance between steel, fluid, cement and formation, as well as the annular composition, determines how the acoustic wavetrain is attenuated, and the resultant amplitude of the first arrival. Analysis of the near receiver amplitude via a fixed or sliding gate algorithm is used to determine the casing to cement bond. High amplitude values indicate poor cement to casing bond, while low values indicate good bond.

The amplitude is used to create a bond index which indicates the circumferential percentage of casing bond or no bond. The variable density log (VDL), is used to qualitatively assess the cement bond quality and integrity to both casing and formation.



The RBL also provides a high resolution cement map through a radial array of eight segmented receivers. Each sector receiver contributes a 45° segment of the casing to cement interface. The derived cement map is a colour representation of the first arrival amplitude of each sector. The segmented receivers are able to identify cement voids and channeling down to 22.5° in width.

Applications

- Cement bond quality and integrity to both casing and formation
- Efficacy of zonal isolation
- Location of free pipe
- Top of cement
- Identification of micro-annulus
- Identification of cement voids and channels
- Assessing if cement remediation is required
- Post remediation evaluation

Features

- Hostile temperature and pressure ratings o 204 °C & 25,000 psi
- 24 kHz piezoelectric transmitter
- Piezoelectric 3 and 5 ft spaced omni receivers
- Radial array of 8, 45° segmented receivers
- Isolated sector receivers provide higher radial resolutions
- High resolution circumferential cement map
- Borehole temperature
- VDL, amplitude and transit time for quantitative and qualitative evaluation of the cement bond quality
- Fixed or sliding gate picking of E3 arrival
- Gamma ray and CCL measurements for depth correlation
- Inline roller centralisers maintain tool centralisation through all casing sizes

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Radial Bond Log

(RBL)

Georesources

- Coal mine exploration and production
- Coal seam gas
- Conventional Oil and Gas
- Unconventional Oil and Gas
- Hydrogeology

Mechanical specifications

Outside Diameter (OD)	69 mm	2.75 in
Length	396 cm	156 in
Weight in Air	68kg	150 lb
Pressure Rating	172.0 MPa	25,000 psi
Temperature Rating	204 °C	400 °F
Min. Casing Diameter	102 mm	4.0 in
Max. Casing Diameter	264 mm	10.8 in
Logging Speed	9 m/min (540 m/hr)	30 ft/min (1,800 ft/hr)
Borehole Fluid	Brine, Water Based Mud (WBM), Oil Based Mud (OBM)	
Sample Interval	User selectable (1, 2, 10, 20 cm)	
Transmitter	Monopole Piezoelectric @ 24 kHz	
Receivers Omni	Piezoelectric, 2 RX @ 91, 152 cm (3, 5 ft) spacings	
Receivers Sector	Piezoelectric, 8 Radial RX @ 61 cm (2 ft) spacing	
Sector Phasing		45°

Measurement specifications

	Gamma Ray	0 – 10,000 API
	Receiver Time Domain	0 – 2,000 µsec
Range	Receiver Amplitude	-2,500 mV – 2,500 mV
	Temperature	-20 – 205 °C (-4 – 400 °F)
	Casing Collar Locator	-10,000 mV – 10,000 mV
	Gamma Ray	+/- 5% of measured value
	Receiver Time Domain	+/- 0.5 µsec
Accuracy	Receiver Amplitude	+/- 2% of measured value
	Temperature	+/- 0.5 °C
	GRRT in GAPI	Gamma Ray
	TRNR in µsec	Near Transit Time
	TRFR in µsec	Far Transit Time
	AMPN in mV	Normalised Near Amplitude
	AMPF in mV	Normalised Far Amplitude
	AMPR in mV	Free Pipe Amplitude Ref
	BOND in %	Bond Index
Sonde Curves	AMP1 – 8 in mV	Sector 1 – 8 Amplitude
and Mnemonics	RMAP array (45°, mV)	Radial Bond Energy Map
	EMIN in mV	Min Sector Energy
	EAVG in mV	Avg Sector Energy
	EMAX in mV	Max Sector Energy
	CCL in CPS or mV	Casing Collar Locator
	VDL3 array (µsec, mV)	Near Variable Density Log
	VDL5 array (µsec, mV)	Far Variable Density Log
	TEMP in DEG °C or °F	Borehole Temperature
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Technical Specification Sheet

C,teq

2³/₄" Radial Bond Log Tool

(RBT)

The 2³/₄" Radial Bond Tool (RBT) is a high pressure, high temperature cement evaluation tool which provides a clear 360° cement map behind casing using 8 segmented receivers which are each spaced 45° apart.

Applications

- Cased hole
- Mud
- Brine

Specifications

Pressure	25,000 psi	1,723 bar
Temperature	400 °F	204 °C
Tool length	9.0 ft	2.7 m
Tool O.D.	2.75 in	70 mm
Min. Borehole size	4.5 in	114 mm
Max. Borehole size	10.375 in	264 mm

Measurement range

Near spacing (TT/CBL)		3 ft	
Far spacing (VDL)		5 ft	
Radial spacing		2 ft	
Max. Logging Speed	30 ft/min	9.1 m/min	



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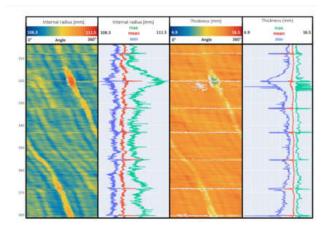
Nusonix Inspect Tool

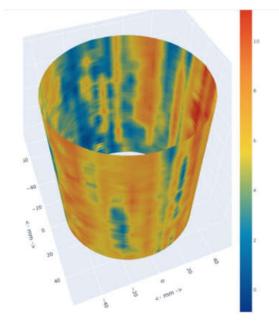
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The Nusonic Inpsect Tool (NIT), provides quantitative and qualitative evaluation of the cement bond quality and other barrier material between casing and formation. High resolution azimuthal coverage identifies cement channels to 6°. Ultrasonic measurements also identify casing corrosion measuring the inside diameter and casing thickness. Assisting in characterizing well integrity by evaluation of the critical componetnts:

- Cement quality
- Cement bonding coverage
- Casing thickness
- Casing geometry

The NIT is a compact casing and tubing inspection tool with improved resolution and accuracy to standard first generation ultrasonic tools. The URL is a time domain tool based on Ultrahigh fidelity Ultrasonic transducers optimizing accoustic signals at target allowing the tool to directly measure the internal diameter and thickness of the casing and tubing whilst providing a 360° high resolution image CBL measurment. Capable of high accuracy measurements in casing and tubing having thickness between 3.. and more than 25mm. Using Accoustic Resonance Technology (ART in the frequency domain at 100KHz and in excess of 3MHz. The NIT tool has been engineered to be smaller and lighter then existing ultrasonic tools making it quicker and more cost-effective to run.





Applications

- Identify down hole leaks and integrity issues
- Determine high precision casing and tubing wear
- Positioning of subsequent casing
- Corrosion inspection
- Cement bond log

Technical Specification Sheet

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Nusonix Inspect Tool

(NIT)

Features and Benefits

- Slickline or Wireline conveyed 2.125" diameter memory logging tool
- Capable of measuring layered composites (GRE lined liners and flexible lines/hoses)
- 360° high resolution, high accuracy measurements
- Capable of measuring in pressured Gas (>35 bar) as well as liquids (Oil/water/brine)
- Logging speed 20 m/min (standard resolution) 5 m/min (Ultra-high resolution)
- PC based data and report processing.
- Output data industry standard will integrity (2D/3D) visualization packages
- Complete download of processed data in 90 mins.

Outside Diameter (OD) 54 mm or 66.7 mm 2.125 in or 2.625 in Length 404 cm 159 in Weight in Air 42kg 92.6 lb **Pressure Rating** 55.1 MPa 8000 psi **Temperature Rating** 115 °C 239 °F **Min. Casing Diameter** 88.9 mm 3.5 in Max. Casing Diameter 339 mm 13.375 in Stand-off range (Fluid) 30 mm – 100 mm Stand-off range (Gas) 22 mm - 100 mm Well fluid compatibility Water/oil/brine/gas (calliper only in gas < 35 Bar) **Logging Speed Low** 20 m/min (1200 m/hr) 65 ft/min (3937 ft/hr) Resolution **Logging Speed High** 10 m/min (600 m/hr) 32.5 ft/min (1950 ft/hr) Resolution **Borehole Fluid** Brine, Water Based Mud (WBM), Oil Based Mud (OBM) **Angular Detection** 60 samples/Revolution @180 RPM **Transducer Configuration** Single Rotating 2000m Hi Resolution, 7000m Low Resolution **Battery Memory Life Receivers Sector** Piezoelectric, 8 Radial RX @ 61 cm (2 ft) spacing **Detection Resolution** Ø 2.0 mm defects Wall thickness resolution < 0.1 mm **Calliper Accuracy** < 0.1 mm USB 2+ **Communication Interface Data Processing** Onsite PC **Download** duration +/- 120 mins (Depending on run time length) Centralised integrated centraliser rollers **Integrated Sensor** Pressure, Temperature, IMU **Environmental Correction** Wellbore medium (Speed of sound detection)

Technical Specifications

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Impeller Flow Meter Sonde



(IFS)

The Impeller Flowmeter Sonde (IFS), comprises a hydrodynamic impeller, whose shaft is mounted on very low friction bearings. A high resolution optical encoder is magnetically coupled to the impeller shaft to measure rotational speed and direction (RPS).

The IFS is used to measure wellbore fluid flow, velocity and direction across production and injection intervals. Fluid flow rotates the impeller, resulting in an RPS measurement that are positive or negative depending on spin direction.

Multiple INRUN and OUTRUN logging passes are performed across the production or injection interval, at different logging speeds. This enables quantitative analysis of the flow.

The impeller response can be calibrated against known inside casing diameter or a reference caliper log to produce flow rate and flow velocity. The calibration is derived by analysis of all INRUN and OUTRUN passes, when plotted on a Cartesian graph of RPS against logging speed.

Applications

- · Identifying production and injection intervals
- Evaluation of fracture stimulation and acid injection
- Determination of fluid flow direction
- · Determination of fluid flow rate and velocity
- Identification of casing leaks
- Percentage contribution of aquifer to total fluid flow

Features

- Low friction bearings minimises flow required to turn impeller
- Optical encoder to measure rotation 256 pulses per impeller revolution
- Different diameter impellers and cages available to suit different casing diameters
- Impellers can be custom made to suit specific flow applications
- Wide range of fluid flow rates

Georesources

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- Casing integrity investigations
- Coal seam gas
- Conventional Oil and Gas
- Unconventional Oil and Gas
- Hydrogeology

	Gamma Ray	Depth	Down	Logging F	Rates	Down 10 m/min				Produc	tion F	Rate			
0	GAPI 200	1m:200m	-50	M/MIN	50	-4000 REV/M 1000	0			L	/S				3
			Upl	Logging Ra	ates	Up 10 m/min			Proc	luction	Com	posit	tion		
			-50	M/MIN	50	-4000 REV/M 1000	0			%F	LOW			-	1
						Down 20 m/min				Prod	luctio				
						-4000 REV/M 1000				1100					
						Up 20 m/min	_			No Pro	oduct	ion			
						-4000 REV/M 1000									
						Down 30 m/m									
						-4000 REV/M 1000									
						Up 30 m/m									
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Qteq

(IFS)

Mechanical specifications

Outside Diameter (OD)	42 mm	1.7 in		
Length	152 cm	60 in		
Weight in Air	7 kg	16 lb		
Pressure Rating	17.2 MPa	2,500 psi		
Temperature Rating	75 °C	167 °F		
Min. Borehole Diameter	85 mm	3.4 in		
Max. Borehole Diameter	400 mm	15.75 in		
Logging Speed	5 – 30 m/min 16.4 – 98 ft			
Borehole Fluid	Fresh and Saline Water			
Sample Interval	User Selectable (0.5, 1, 2, 10, 20 cm)			
Impeller	4 blade PEEK, 15.9 mm (0.625 in) pitch			
Impeller Diameter	76.2 or 101.6 mm (3.0 or 4.0 in)			
Motion Detector	Optical rotary encoder, 256 pulse per revolution			

Measurement specifications

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Plug/Packer Setting Tool

Qteq

(BST)

The BST reliably and efficiently sets a wide range of packers, retainers and plugs, including composite frac plugs.

The Plug/Packer Setting Tool provides a reliable method of setting plugs and packers. The tool uses pressure built up by burning a powder charge in the combustion chamber. The high-pressure gas that comes from the burning powder charge provides the gradual development of force. The force in the setting tool strokes a mandrel to set the bridge plugs, cement retainers, and production packers.

Applications

- The BST Sets production packers, cement retainers and bridge plugs
- · Identifying filter cake, and permeable formations
- Assessing formation geometry for packer setting

Features

- The packer/plug setting tool sets bridge plugs, retainers, and packers faster than drill pipe based techniques
- The pressure-balanced design of the tool avoids the need to overcome well pressure when setting
- Standard and Slow Set setting charges are available
- Industry-standard connections make the tool compatible with most plug and packer sizes

Georesources

- Coal mine exploration and production
- Coal seam gas
- Conventional Oil and Gas
- Unconventional Oil and Gas
- Base metals
- Industrial and metallic minerals
- Hydrogeology
- In situ leach (borehole mining

Mechanical specifications

Туре	#05	#10	#20			
Size	1.718 in (43.64 mm)	2.75 in (69.85 mm)	3.80 in (96.52 mm)			
Weight	38 lb (17.24 kg)	67 lb (30.39 kg)	156 lb (70.76 kg)			
Length	6.18 ft (1.88 m)	5.32 ft (1.62 m)	6.24 ft (1.90 m)			
Temperature (ma	ix.)	400°F (232 °C)				
Pressure (max.)	27,000 psi (186.16 MPa)	15,000 psi (103.42 MPa)	15,000 psi (103.42 MPa)			
Setting force	10,000 lbf (44.48 kN)	35,000 lbf (155.69 kN)	55,000 lbf (244.65 kN)			
Range	2.375 to 4.50 in (60.3 to 114.3 mm)	3 3.50 to 5.50 in (88.90 to 139.70 mm)	5.0 to 13.375 in (127.00 to 339.73 mm)			

Junk Basket / Gauge Ring

Qteq's Junk Basket with Gauge Ring is used to remove debris and to gauge the ID of the casing prior to running tools in hole.

Tools and completion equipment that have an outer diameter close to the internal diameter of casing or tubing, require careful attention to ensure a clear path for running operations. Small amounts of debris or casing irregularity and restrictions can cause damage to equipment, or potentially getting equipment stuck in hole resulting in costly and complex fishing operations.

A wireline junk basket combined with a suitable sized gauge ring performs two tasks in a quick single run. As the junk basket runs in the well, debris is collected from the bottom opening and trapped inside the tool. When the tool is retrieved to surface, the basket is sealed against the rod trapping debris. The gauge ring size is selectable and typically slightly larger than the outer diameter of any equipment to be subsequently run-in hole.

Benefits

- Reduces rig time by retrieving debris and gauging the hole in one trip
- Saves time when retrieving debris from inside the casing compared to using pipe for the same purpose
- Enables simple, straightforward application for safe, quick operations
- Enables packers, plugs, and other equipment to pass easily through the intended path in future runs

Features

- Simple design with gauge ring and junk basket combined into one tool
- Multiple size gauge rings are available and customisable upon request

Mechanical Specifications

Model No.	05	10	20			
Size	1.69 in. (42.93 mm)	2.75 in. 69.85 mm)	4 in. (101.6 mm)			
Weight	18 lb (8.18 kg)	28 lb (12.73 kg)	60 lb (27.27 kg)			
Length	70 in. (1778 mm)	70 in. (1778 mm)	81 in. (2057.4 mm)			
Range	1.71 to 2.87 in. (43.43 to 72.89 mm)	3 to 7.15 in. (76.2 to 181.61 mm)	4 to 8.34 in. (101.6 to 211.84 mm)			

Perforating Systems



Perforations are required to provide an effective flow communication between cased wellbore and the productive reservoir. The gun punches a pattern of perforations, using shaped charge explosives, through the casing and cement sheath (annulus) into the formation.

The tip velocity of the perforation front can reach up to 7,500 to 9,000 m/sec with an impact pressure of approximately 10 to 15 million psi.

Qteq offers TCP and Wireline firing systems. Wireline firing systems have the option of an advance Radio Safe ignition system

Qteq can offer a wide range of gun systems and sizes. Systems include scallop guns, through tubing exposed and encapsulated gun types.

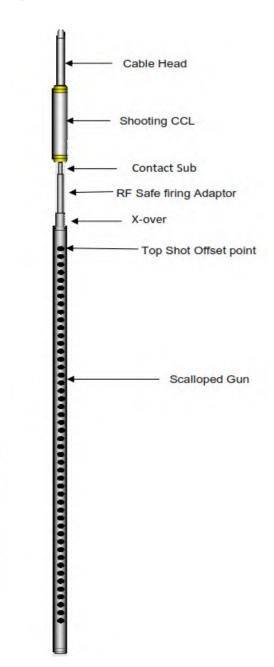
A CCL is run in conjunction for correlation purposes to assist in perforating depth control.

Features

- OD to match wellbore casing
- Shot density (shots/m) dependant on requirements
- Variable charge performance (entry hole size, Perf distance)
- Delivery systems (Hollow steel carriers, Exposed systems)
- Variable length of perf zone (Gun Length)

Georesources

- Coal seam gas
- Conventional Oil and Gas
- Unconventional Oil and Gas
- Water wells
- Well Abandonment



Gun Maps Example Shot Densities

12 1

24 h

4 spf, 90° phasing

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12 ir

24 ir

6 spf, 60° phasing

Pressure Activate Firing Head (LP)

(PAFH)

The Pressure Activated Firing Head (LP) was developed for use where pressure firing is required, including horizontal wells, well stimulation or as a backup firing system.

These tools utilize precision shear pin technology with an accuracy of +/- 5%.

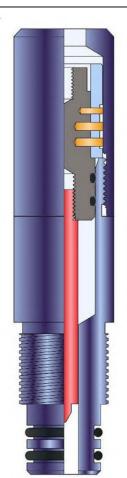
This low pressure system can be set to activate at predetermined pressures ranging from 2,000 to 8,000 psi by utilizing two sizes of precision shears.

Features

- Can be utilized with most Top Subs or an Automatic Release Firing Head
- Can be Used with Time Delay Fuses
- Suited for highly deviated wells
- Can be run on Coil Tubing
- Can be run on Slick Line or Electric Line
- Minimum operating pressure 2,000 psi (14 MPa)
- Maximum operating pressure 18,000 psi (124 MPa)
- Requires pinning to 8,000 psi (55 MPa) to pass API RP-67 drop testing

Mechanical specifications

0.D.	1.69″	43 mm
Make-up Length	4.75″	121 mm
Temperature (max.)	250 °	f (121 °C)
Hydrostatic (max.)	18,000 psi	124 Mpa
Hydrostatic (min.)	2,000 psi	13.8 MPa







Radial Cutting Torch



(RCT)

MCR's Radial Cutting Torch[™] tool is the safest and most efficient pipe cutting device available in the industry. Based on patented cutting technology, MCR's Radial Cutting Torch tool, or RCT[™] tool, is used to sever tubing, casing, drill pipe, and coiled tubing without the use of explosives or hazardous materials, making it one of the safest pipe cutting tools on the market.

The patented nozzle and proprietary mixture of various powdered metals produces jets of highly energized plasma to cut virtually any type of pipe in any well condition. Because RCT cutting technology does not use explosives or hazardous chemicals, the tool can be shipped almost anywhere in the world within 24 hours, saving significant time and associated costs, while remaining compliant with safety regulations.

MCR's Radial Cutting Torch assembly is lowered into the well until the desired depth is reached. MCR's Thermal GeneratorTM (THGTM) activator activates the primary fuel load; highly energized plasma is produced causing an increase in internal pressure. Once the pressure produced inside the torch exceeds that of the well bore, the protective sleeve is displaced exposing the nozzle to the well bore. Plasma exits thru the nozzle to sever the target in drilling, completion, production, or recovery scenarios, within wellbore temperatures up to 500 °F (260 °C) and pressures up to 10,000 psi (69 MPa).

Applications

- Standard severance applications
- HT environments
- Custom tool available

Features & Benefits

- Undersized for restrictions
- Non-Explosive
- Radio Safe

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- Operates in temperatures to 500 °F (260 °C) & pressures up to 10,000 psi (69 MPa) (see XRT tool systems for HPHT requirements)
- Cuts all steel, high chrome, plastic coated tubulars, Inconel®, Monel®, Hastelloy® and exotic pipe
- Non-hazmat fuel systems available
- Cuts are flare-free and do not produce swelling
- · Cuts in fluids or dry pipe, heavy drilling fluids
- Deployable within hours not days
- Minimizes downtime and associated costs
- Approved for all methods of transport
- Non-hazmat rated RCT-SP series of torches available



MCR, Radial Cutting Torch, RCT, Thermal Generator, THG and XRT are trademarks of MCR Oil Tools, LLC. and Affiliates

Perforating Torch Cutter

Qteq

(PTC)

MCR's Perforating Torch Cutter[™] tool provides the industry with a safe, efficient and reliable pipe punching alternative to explosives. MCR's Perforating Torch Cutter tool effectively perforates coiled tubing, tubing, casing and drill pipe without the use of restrictive technologies. When running a job that requires adequate flow into the annulus, explosive perforators and punchers are unreliable in many configurations at producing a consistent or sufficient hole in pipe. MCR's line of punchers allow operators to perforate or circulate with confidence while relying on MCR's field proven technology.

The patented nozzle and proprietary mixture of various powdered metals produces jets of highly energized plasma to perforate virtually any type of pipe in any well condition. Because the PTC^M tool does not use explosives or hazardous chemicals, the tool can be shipped almost anywhere in the world within 24 hours, saving significant time and associated costs, while remaining compliant with safety regulations.

MCR's Perforating Torch Cutter assembly is lowered into the well to the desired depth. Activation of the Thermal Generator activator activates the primary fuel load causing an increase in internal pressure. Following internal pressure rise, plasma exits thru the side of the torch nozzle and perforates the target pipe. With single nozzle systems the PTC cutting jet forces the tool against the wall of the pipe producing high frictional forces between the PTC and the wall of the pipe resulting in a stabilized torch and successful penetration.

Applications

- Standard punching applications
- HPHT environments
- Custom tool available

Features & Benefits

- Undersized punching through restrictions
- Non-Explosive
- Radio Safe
- Operates in temperatures to 1,000 °F (538 °C) & pressures up to 30,000 psi (207 MPa)
- Perforates all steel, high chrome, plastic coated tubulars
- Non-hazmat fuel systems available
- Single / Dual perforations in flow areas from
- 0.38 in2 to 7.0 in2

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- Deployable within hours not days
- Minimizes downtime and associated costs
- Approved for all methods of transport



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WIRELINE SERVICES

TECHNICAL SPECIFICATION SHEETS

ANCILLARY SERVICES

Downhole Fluid Sampling Tool



(DFST)

The Downhole Fluid Sampling tool is designed to provide a single dowhnole fluid sample at a user specified depth. The fluid sample is 1 litre and transfered to surface at pressure.

The sample can be transferred at surface to a suitable transport container.

The Fluid Sampler tool operates by opening a motorised orifice which can be sealed for the sample to be transfered to surface for analysis.

Applications

• Taking representative borehole fluid samples

Features

- Large 1 Litre capacity
- Slim version of tool available.
- Sample taken and returned to surface at pressure

Georesources

- Coal mine exploration and production
- Coal seam gas
- Conventional Oil and Gas
- Unconventional Oil and Gas
- Base metals
- Industrial and metallic minerals
- Hydrogeology
- In situ leach (borehole mining

(DFST)

Mechanical specifications (standard tool)

Outside Diameter (OD)	51 mm	2.0 in
Length	155 cm	61.0 in
Weight in Air	11.8 kg	26 lb
Pressure Rating	20.68 Mpa	3,000 psi
Temperature Rating	85 °C	185 °F
Min. Borehole Diameter	64 mm	2.5 in
Max. Borehole Diameter	No Limit	
Borehole Fluid	Any	
Sample Depth	User selecta	ible
Sample Chamber Activation	Mechanical Motori	sed Orifice

Measurement specifications (standard tool)

Fluid Sample Capacity

1 Litre (1.25 Litre available)

Mechanical specifications (slim tool)

Outside Diameter (OD)	38 mm	1.5 in
Length	188 cm	74 in
Weight in Air	5 kg	11 lb
Pressure Rating	20 Mpa	2,900 psi
Temperature Rating	70 °C	160 °F
Min. Borehole Diameter	51 mm	2.0 in
Max. Borehole Diameter		No Limit
Borehole Fluid		Any
Sample Depth	U	ser selectable
Sample Chamber Activation	Mechanio	al Motorised Orifice

Measurement specifications (slim tool)

Fluid Sample Capacity

1 Litre (1.25 Litre available)

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Technical Specification Sheet

C)teq

Motorised Free Point Tool

Qteq

(FPT)

Qteq's Motorised Free Point Tool accurately determines the stuck point in pipe, tubing or a casing string. Its real-time data allows the operator to make rapid, informed decisions regarding the next steps for recovering a stuck downhole assembly.

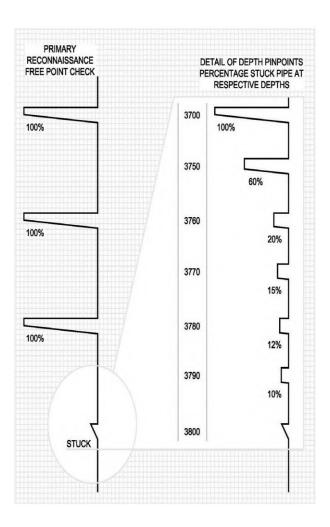
The Hall sensor picks up movements in the assembly associated with tension, compression or torque measurements and converts that to an AC signal. This signal is then processed at surface by the Free Point Panel for display and recording for permanent records.

Benefits

- Real-time data assists in optimising pipe recovery methods
- Accurate depth determination of stuck assembly
- Controlled electronics protect damage to gear and drive assemblies
- Interchangeable anchors for different assemblies
- Warrior compatibility allows creation of a printable log

Features

- 375 °F operation
- Tension, compression and torque measurements
- Built in Casing Collar Locator (CCL)
- Solid-state electronic motor control
- Full open/close sensors
- Seven anchor sizes available for most applications
- Temperature stable Hall sensor





Technical Specification Sheet

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Qteq

(FPT)

Mechanical specifications

Outside Diameter (OD)	37 mm	1-7/16 in
Length	254 cm	100 in
Weight in Air	20 kg	45 lb
Pressure Rating	103 MPa	15,000 psi
Temperature Rating	191 °C	375 °F
Min. Pipe Diameter	45mm	1.77 in
Max. Pipe Diameter	287 mm	11.27 in
Logging Speed CCL	18m/min	13,600 ft/hr
Borehole Fluid	No Limitat	ion
Strength/Torque Sensor	Magnetic Hall F	Flux Gap

Anchor selection chart

Closed diameter inches / mm	Open diameter inches /mm
1.43 / 37	2.74 / 70 @ 45°
1.43 / 37	4.17 / 106 @ 45°
1.43 / 40	5.56 / 141 @ 45°
4.10 / 104	5.28 / 134 @ 30°
4.10 / 104	6.43 / 163 @ 30°
5.86 / 149	8.40 / 213 @ 30° 9.17 / 22 @ 45°
7.38 / 187	10.52 / 267 @ 30° 11.27 / 286 @ 45°

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Back Off Service

(BO)



The Back-Off service recovers pipe sections without pipe strings.

The Back off tool is lowered into the well and positioned in the desired joint using a collar locator for accurate placement. Reverse torque is applied to the pipe from the surface. The tool is then fired to deliver shock waves to the joint. The shock waves and reverse torque combine to loosen the joint.

To make a successful Back off, operators must determine pipe size, weight, and condition: the depth of back off, the mud or fluid weight, and the well temperature.

Applications

- Open hole
- Cased hole

Specifications

Diameter		5/8 to 1-7/16 inc	
Charge		RDX/HMX/HNS	
Application	For applications fro	om 1 in tubing up to 1	3-5/8 in drill collars
Pressure		25,000 psi (172 Mpa)	
Temperature	325 °F 163 ℃	400 °F (204 °C)	500 °F (260 °C)

Three Arm Caliper

Qteq

(3CAL)

The Three Arm Caliper (3CAL), provides an omni axis caliper measurement. Three caliper arms are configured in an omni axis arrangement, with each caliper phased at 120 degrees, circumferentially around the sonde long axis.

All caliper arms are interdependently spring loaded, whereby a common compression spring provides sufficient sidewall force to maintain contact with the borehole wall. The compression spring also absorbs caliper arm movement as a result of changes in borehole diameter through sections of enlargements, restrictions, washouts, breakout and rugosity.

Caliper arms are motorised open and closed by a DC gear motor. A push rod mechanism drives a linear potentiometer that varies its output dependant on caliper arm movement.

Due to the interdependency of the caliper mechanism, all three caliper arms are coupled, and respond jointly. This results in a single omni axis measurement, which is more representative of borehole diameter than single or dual arm calipers.

The sonde also includes a natural gamma ray measurement for depth correlation.

Applications

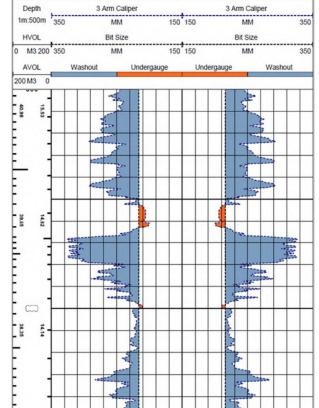
- · Caliper corrections for geophysical wireline data
- Identifying borehole elongation, rugosity and washouts
- · Assessing efficacy of under-reaming operations
- Borehole geometry of induced cavities used for in situ leaching size, orientation and depth
- · High resolution annular and hole volumes
- Blast hole shot optimisation
- Casing and tubular integrity investigation, quantifying wear, damage, corrosion and restrictions to casing, tubing, screens and production strings
- Identifying filter cake, and permeable formations
- Assessing formation geometry for packer setting

Features

- Omni axis diameter measurement
- Fast logging speeds of up to 20 m/min
- Inline swivel to reduce sonde rotation
- Gamma ray and CCL measurements for depth correlation
- More accurate annular and hole volumes, than compared with single, dual arm calipers
- Extended caliper arm option to 1,168 mm (46.0 in) available

Georesources

- Coal mine exploration and production
- Coal seam gas
- Conventional Oil and Gas
- Unconventional Oil and Gas
- Base metals
- Industrial and metallic minerals
- Hydrogeology
- In situ leach (borehole mining



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Three Arm Caliper

Qteq

(3CAL)

Mechanical specifications

Outside Diameter (OD)	51 mm	2.0 in
Length	264 cm	104.0 in
Weight in Air	21 kg	54 lb
Pressure Rating	27.5 MPa	4,000 psi
Temperature Rating	85 °C	185 °F
Min. Borehole Diameter	76 mm	3.0 in
Max. Borehole Diameter	864 mm	34.0 in
Logging Speed	9 m/min (540 m/hr)	30 ft/min (1,800 ft/hr)
Borehole Fluid	Air, Water Based Mud (WBM),	Oil Based Mud (OBM)
Sample Interval	User selectable (0.5, 1	, 2, 10, 20 cm)
Caliper Arrangement	3 caliper arms at 120° sp	acing – omni axis
Casing Collar Locator	Optiona	l
Gamma Detector	22 x 102 mm Nal scin	tillation crystal
Caliper Measurement	Linear potenti	ometer

Measurement specifications

Danas	Gamma Ray	0 – 400,000 API
Range -	Caliper	0 – 864 mm (0 – 34.0 in)
	Casing Collar Locator	-10,000 mV – 10,000 mV
Accuracy -	Gamma Ray	+/- 5% of measured value
	Calliper	+/- 2.54 mm (0.10 in)
	GR3C in GAPI	Gamma Ray
Sonde Curves	CAL3 in mm	Caliper Omni Axis
and whether ones	CCL in CPS or mV	Casing Collar Locator
	HVOL / AVOL in m ³	Hole / Annular Volume

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WIRELINE SERVICES

TECHNICAL SPECIFICATION SHEETS

GYROSCOPIC DEVIATION

Gyroscopes



		Surface Read O Gyro	Surface Read Out Spinning Mass Gyro (SRS)	Surface Re	ad Out North Seeking Gyro (SRN)		Surface Read Out MEMS Gyro (SRM)	Memory North Seeking Gyro (MNG)	orth Seeking Gyro (MNG)	Memory MEM	Memory MEMS Gyro (MMG)
utside Dia	Outside Diameter (OD)	45 mm	1.75 in	42 mm	1.65 in	38 mm	1.50 in	36 mm	1.42 in	43 mm	1.70 in
Length		243 cm	95.67 in	135 cm	53.15 in	120 cm	47.25 in	130 cm	51.18 in	218 cm	85.98 in
Weight in Air	ir	13 kg	29 lb	8 kg	18 lb	23 kg	51 lb	9 kg	20 lb	23 kg	51 lb
Pressure Rating	ting	228 bar	3,300 psi	690 bar	16,500 psi	206 bar	3,000 psi	380 bar	5,500 psi	690 bar	10,000 psi
Temperature Rating	e Rating	D. 06	194 °F	85 °C	185 °F	70 °C	158 °F	70.C	158 °F	80 °C	176 F
•		:		1				;		1	
lin. Boreho	Min. Borenole Diameter	00 mm	UI 05-2	00 mm	UI 057	00 MM	UI 05-2	00 mm	UI 077	00 mm	UI 05:2
Max. Borehole Logging Speed	Max. Borehole Diameter Logging Speed	355 mm 15 m/min (900 m/hr)	14.0 in 49 ft/min (2,950 ft/hr)	355 mm 150 m/min	14.0 in 492 ft/min	355 m 9 m/min (540 m/hr)	14.0 in 30 ft/min (1,800 ft/min)	355 m 30 m/min (1,800 m/hr)	14.0 in 98 ft/min (5,900 ft/min)	355 mm 30 m/min (1,800 m/hr)	14.0 in 98 ft/min (5,900 ft/min)
Station Time			N/A	N	N/A	2	N/A	150 se	50 seconds	30 sei	30 seconds
vroscope A	Gyroscope Mechanism	Goodrich DG-(Goodrich DG-69 spinning mass	3 axis digi	3 axis digital MEMS	3 axis dig	3 axis digital MEMS	3 axis digi	3 axis digital MEMS	3 axis digi	3 axis digital MEMS
Recording Mode	Mode	Surface	Surface read out	Surface	Surface read out	Surface	Surface read out	Merr	Memory	Men	Memory
Measurement Mode	nt Mode	Continuous – user selectal	Continuous – user selectable intervals (1, 5, 10, 20 cm)	Continuous – user selectabl	Continuous – user selectable intervals (1, 5, 10, 20 cm)	Continuous – user selectal	Continuous – user selectable intervals (1, 5, 10, 20 cm)	Multishot – user selectable	Multishot – user selectable intervals (2.5, 5, 10, 20 m)	Multishot – user selectable	Multishot – user selectable intervals (2.5, 5, 10, 20 m)
Sighting Method	sthod	Optical or azimuthal	Optical or azimuthal pointing system (APS)	North seeking	North seeking self-alignment	Optical or azimuthal	Optical or azimuthal pointing system (APS)	North seeking:	North seeking self-alignment	Optical or azimuthal	Optical or azimuthal pointing system (APS)
	Gamma Rav	0 - 10	0 - 10.000 API								
Range	Deviation	0 - 360	0 – 360°. 0 - 45° (tilt)	0 - 360". 0	0 – 360°. 0 - 180° (tilt)	0 - 360".0	0 – 360°. 0 - 180° (tilt)	0 - 360". 0	0 – 360°. 0 - 180° (tilt)	0 - 360". 0	0 – 360°. 0 - 180° (tilt)
	Gamma Ray	+/- 5% of m	+/- 5% of measured value								
	Azimuth	./+	+/- 0.5°	-/+	+/- 1.0"	-/+	+/- 0.5°	-/+	+/- 1.0"	-/+	+/- 0.5"
Accuracy	Borehole Tilt	-+	+-/ 0.2"	/-+	+-/ 0.1*	-/+	+/- 0.5")/-+	+-/ 0.2"	/-+	+-/ 0.2"
	Optical Sighting	+/- 0.5	+/- 0.5* bearing			+/- 0.5'	+/- 0.5* bearing			+/- 0.5*	+/- 0.5° bearing
	APS	+-/ 0.1	+-/ 0.1° bearing			+-/ 0.1	+-/ 0.1° bearing			+-/ 0.1	+-/ 0.1° bearing
	GRGY in API	Gam	Gamma Ray								
	TILT in deg°	Boret	Borehole Tilt	Boreho	Borehole Tilt	Boreh	Borehole Tilt	Boreho	Borehole Tilt	Boreh	Borehole Tilt
	AZIT in deg°	Borehol	Borehole Azimuth	Borehole	Borehole Azimuth	Borehole	Borehole Azimuth	Borehole	Borehole Azimuth	Borehole	Borehole Azimuth
	TDPTH in m	True	True Depth	True [True Depth	True	True Depth	True [True Depth	True	True Depth
Sonde	DDIFF in m	Delta	Delta Depth	Delta	Delta Depth	Delta	Delta Depth	Delta [Delta Depth	Delta	Delta Depth
Curves and Mnemonics	NDEV in m	North [North Departure	North D	North Departure	North C	North Departure	North De	North Departure	North D.	North Departure
	EDEV in m	East D.	East Departure	East De	East Departure	East Dr	East Departure	East De	East Departure	East De	East Departure
	DIST in m	Horizontal Du	Horizontal Departure from 0			Horizontal De	Horizontal Departure from 0	Horizontal Der	Horizontal Departure from 0	Horizontal De	Horizontal Departure from 0
	AZIM in deg°	Horizontal A	Horizontal Azimuth from 0	Horizontal Az	Horizontal Azimuth from 0	Horizontal A	Horizontal Azimuth from 0	Horizontal Az	Horizontal Azimuth from 0	Horizontal Az	Horizontal Azimuth from 0
	Various			Gum Ouality C	Gvm Outalityr Control Cunves			Gvro Ouality Control Curves	Control Curves	Gum Outalitur (Gvm Ouality Control Curves

Technical Specification Sheet

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WIRELINE SERVICES

TECHNICAL SPECIFICATION SHEETS

DATA SERVICES

Interpretation and consultancy

In addition to the data services usually delivered by wireline companies, **Qteq's Data Services team also provides downhole geosciences consultancy**.

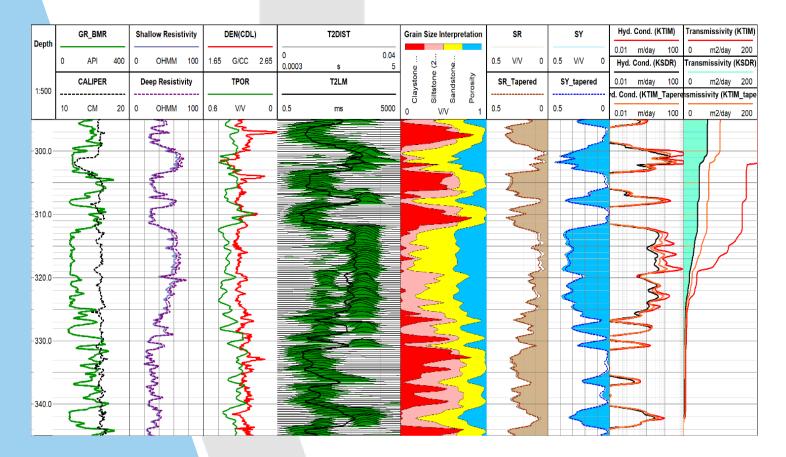
This service involves advanced interpretation of the data sets, adding to the value of basic logs.

We collaborate with our customers to understand the objectives and challenges, and provide fully customised answer products.

As a result of our team of geoscience experts' robust experience in geological settings around the world, we are able to fully utilise downhole data obtained.

Petrophysics and Geomechanics

- Geomechanical analysis using full wave sonic tools measuring compressional and shear velocities. Combined with density measurement, they can be combined to calculate mechanical rock strength properties (e.g. Poisson's ratio), as well as determine secondary porosity systems.
- Full petrophysical interpretation of the logs; this includes a composite log of all relevant logs and quantitative analysis of porosity and saturation that can be applied in all industries from hydrogeology to oil and gas.
- Cased hole services including high resolution (millimeter scale) casing and screen inspection and integrity analysis, and quick look check.
- Advanced processing includes multi-mineral analysis to determine mineral and water volumes at individual depths using advanced oil and gas software.
- Wireline logging consultancy to ensure you get the answers you are after from you logging campaign.
- Core analysis and guidance to support your logging campaign.



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Data services

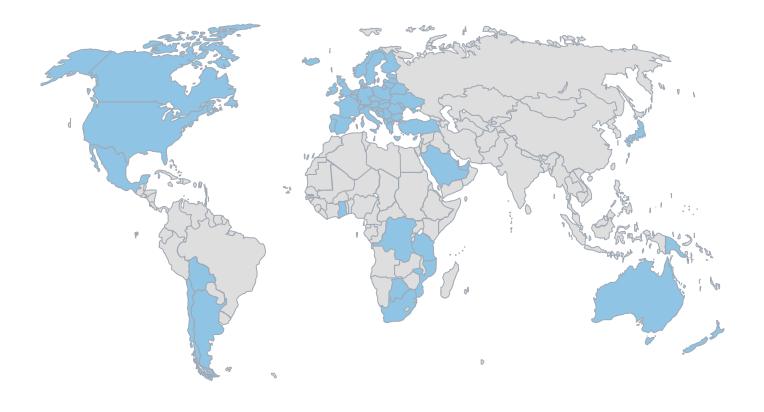


Image Analysis

- Structural configuration analysis including dip analysis of formation beddings and identifying structural units in complex folded and faulted settings.
- Fault and fracture characterisation with identification and detailed analysis of multi-scale natural fractures and faults.
- Sedimentological interpretations by precise inspection of rock texture on images and integration with other data (particularly core data if available). Deliverables can include lithotypes, depofacies, depositional model and identification of unconformities.
- High resolution sequence stratigraphic interpretations combining image and other well log analysis results and regional understanding and sea level changes to pick stratigraphic surface and sedimentary packages.
- Rock defect analysis to pick geotechnical rock defects including bed contacts, joints, faults broken zones and unconformities and their geometric and morphologic attributes such as orientation, spacing, aperture and continuity. Mechanical rock units can also be discriminated based on rock texture, hardness and defect density.
- Geostress characterisation including identifying and analyzing main stress-induced fractures such as borehole breakout and drilling induced fractures to determine the orientation of in-situ stresses. This can be promoted to stress magnitude quantification by incorporation of other well logs such as density and sonic (and core data if available).
- Multi-hole integrated analysis; all analyses described above can equally be performed using multi-hole approach where the confidence and coverage increases noticeably. An expressive conceptual model can be delivered to be used in guiding and verification of any digital 2D and 3D modelling.
- 3D fracture modeling by building a 3D geocellular model of the fracture network using many various sources of data including borehole image analysis of fractures and mechanical rock types. This model is to be used in many operational and E & P activities requiring a predictive knowledge of fractures and their concentration in the target block.
- Cased hole services including high resolution (millimeter scale) casing and screen inspection and integrity analysis and quick look check. This service can be provided in very quick turn-around time of within 24 hours or less if requested.

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